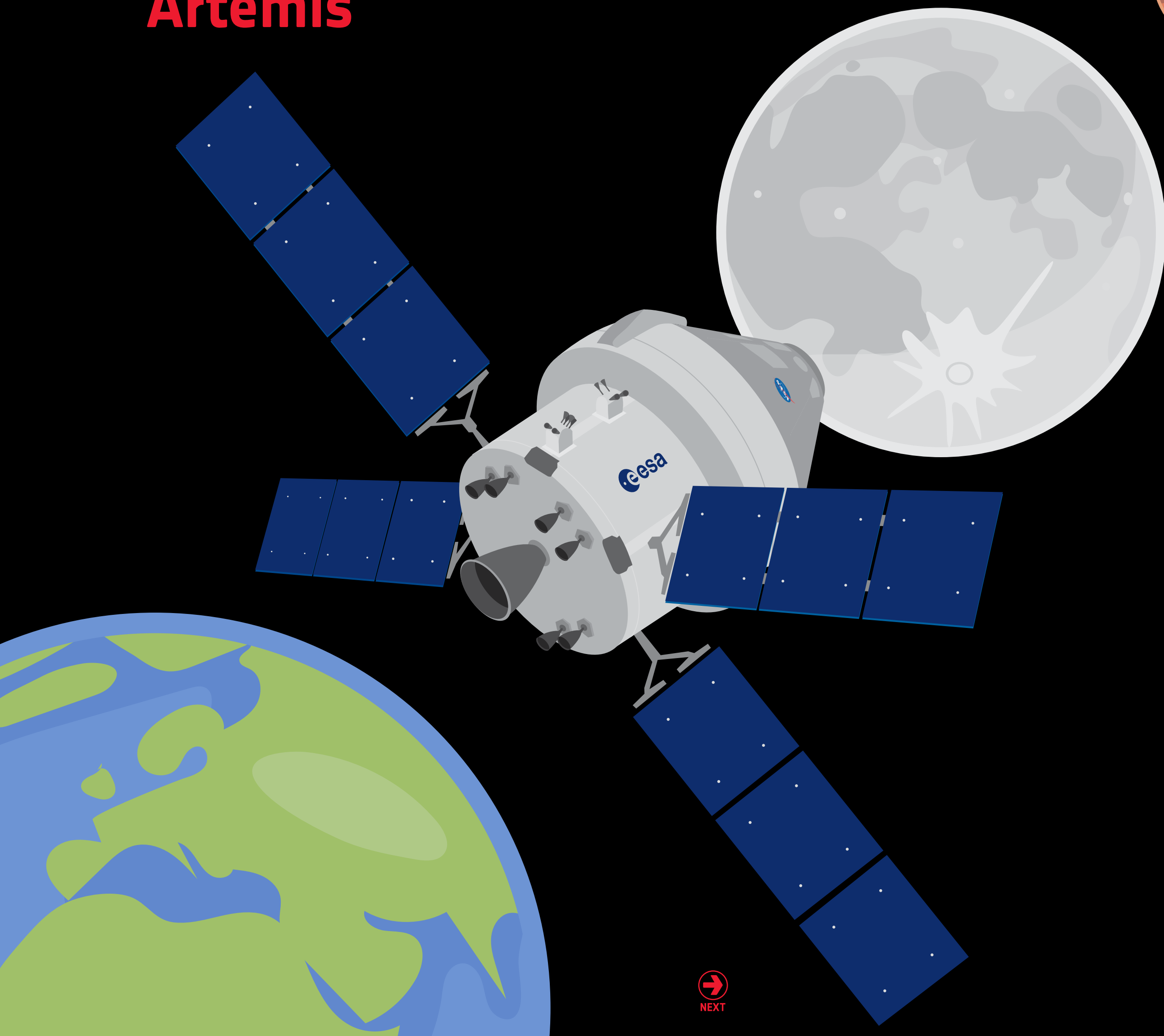


→ ORION

Artemis



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→ ORION

Introduction

Orion is NASA's next exploration spacecraft to send humans into space. It is designed to send astronauts farther into space than ever before, beyond the Moon to asteroids and even Mars.

The first mission, called Artemis 1 will send the spacecraft beyond the Moon and back. This Artemis 1 will not carry a crew but will instead be controlled from the ground.

The spacecraft will perform a flyby of the Moon, using lunar gravity to gain speed and insert itself in a distant retrograde orbit around the Moon. The first Orion will travel 70 000 km beyond the Moon, almost half a million km from Earth – farther than any human has ever travelled.

The total trip will take around 20 days, ending with a splashdown in the Pacific Ocean without the European Service Module – it separates and burns up harmlessly in the atmosphere.

ESA has designed and is overseeing the development of the part of the Orion spacecraft that supplies air, electricity and propulsion. Much like a train engine pulls passenger carriages and supplies power, the European Service Module will take the Orion capsule to its destination and back.

More than 20 companies around Europe are now building the European Service Module as NASA works on Orion and the Space Launch System.

Artemis 2

Work is already well under way for the second mission that will propel astronauts further than ever before, also with a European Service Module.

The crew of up to four astronauts will fly Orion to 70 000 km beyond the Moon before completing a lunar flyby and returning to Earth. The mission can take a minimum of 8 days and will collect valuable flight test data.

Artemis 3

The contract to build the third European Service Module for Orion has been signed. The third Artemis mission will fly astronauts to Earth's natural satellite in 2024 – the first to land on the Moon since Apollo 17 following a hiatus of more than 50 years.

ABOUT THIS DOCUMENT

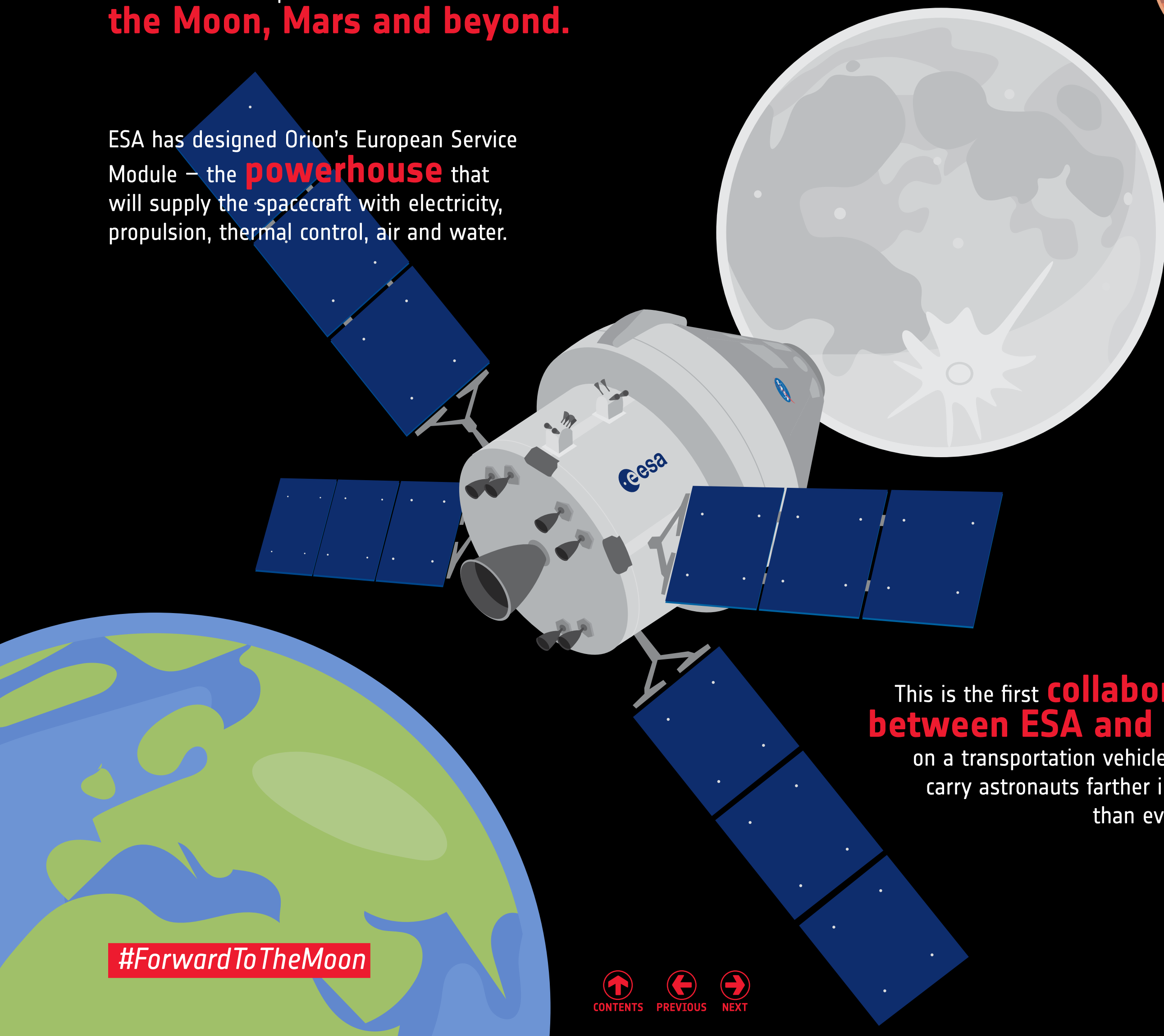
This document contains links to download the images, infographics, videos and to visit web pages for more information. Explore the European Service Module through the series of infographics. Roll over the graphic elements to discover hyperlinks to more information on related webpages. Links to recommended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

→ ORION

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.



This is the first **collaboration between ESA and NASA** on a transportation vehicle that will carry astronauts farther into space than ever before.

#ForwardToTheMoon

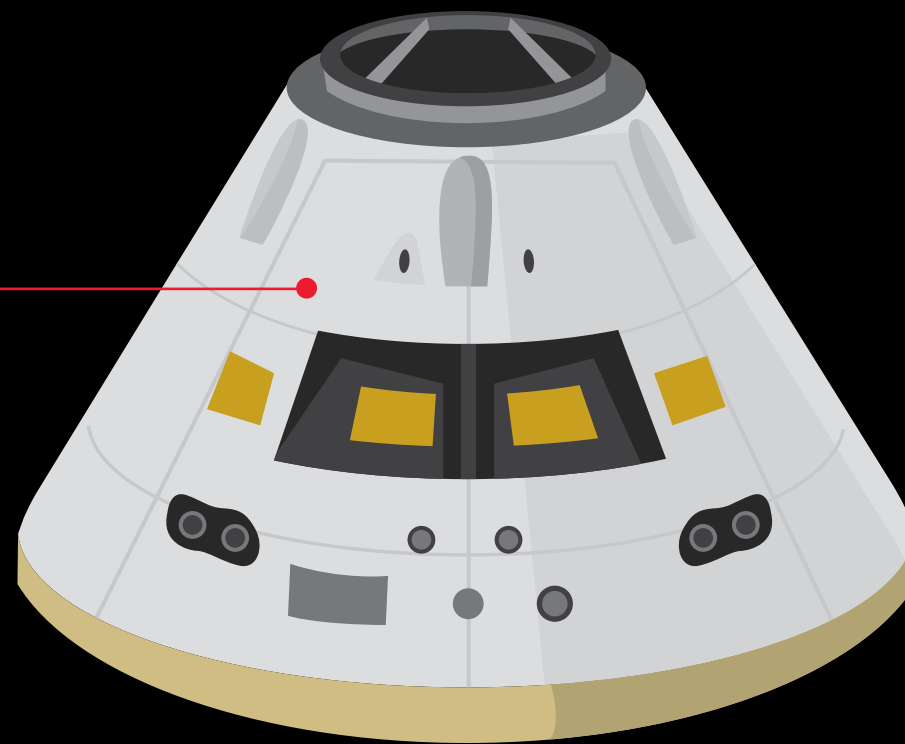
→ ORION

The spacecraft

CREW MODULE

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

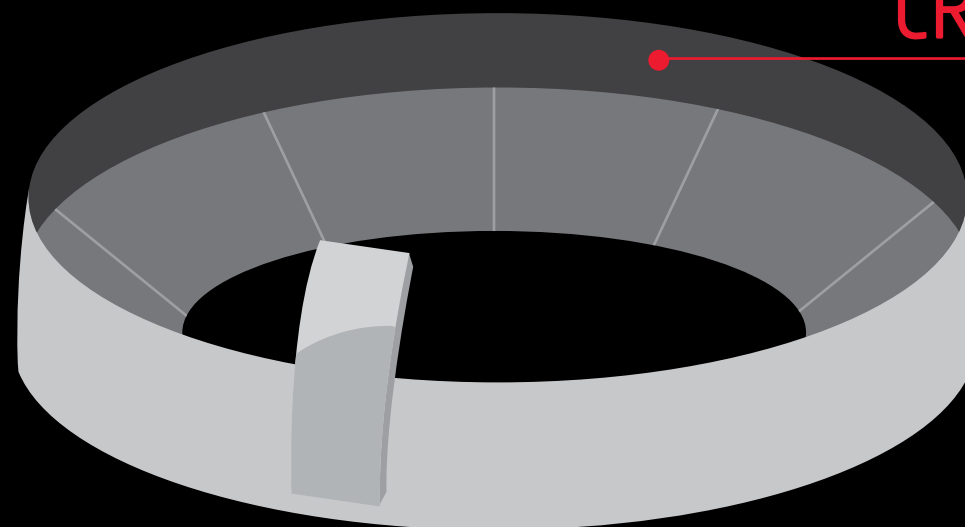
Only part of the spacecraft that **lands back on Earth.**



CREW MODULE ADAPTER

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

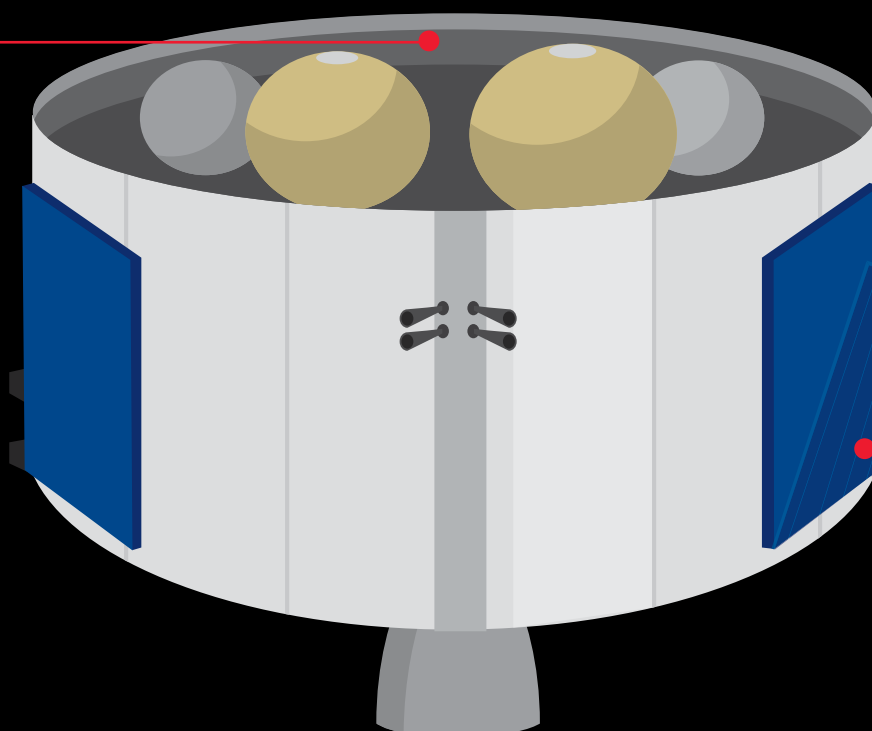
Contains electronic equipment for **communications, power and control.**



EUROPEAN SERVICE MODULE

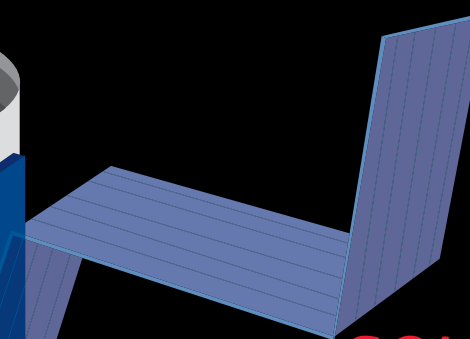
Provides electricity, propulsion, **air and water.**

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



SOLAR ARRAYS

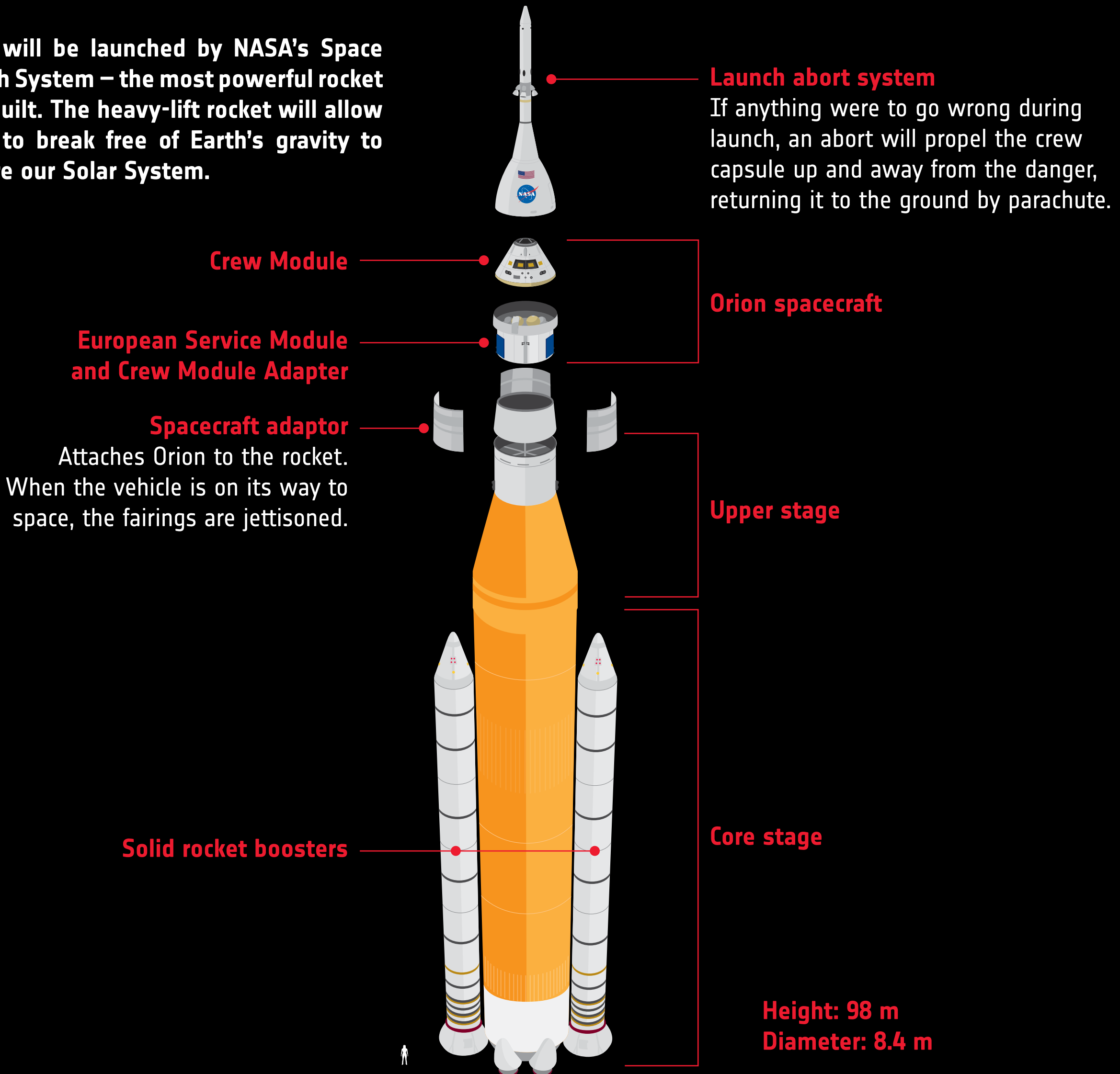
The solar array turns on two axes to remain aligned with the Sun for **maximum power.**



→ ORION

The rocket – how to get to the Moon

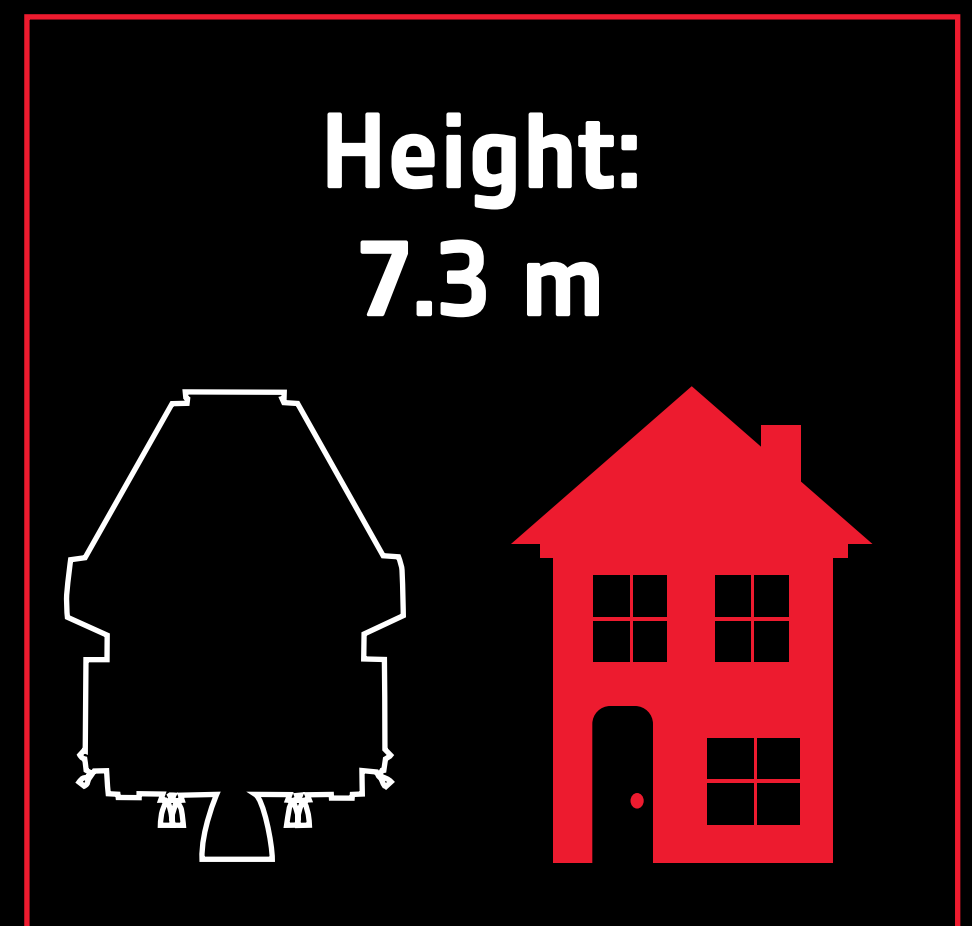
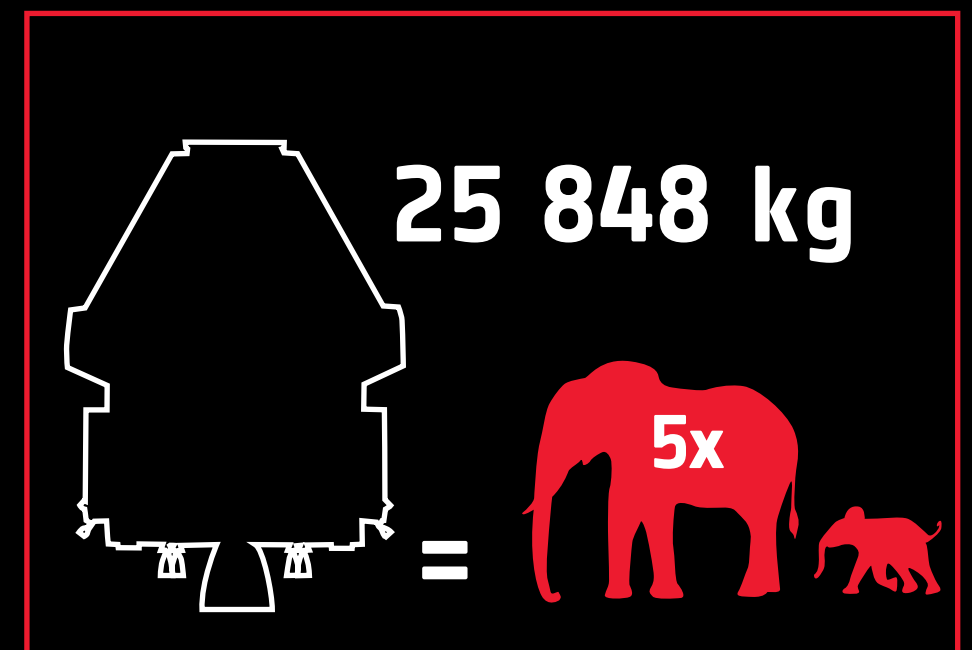
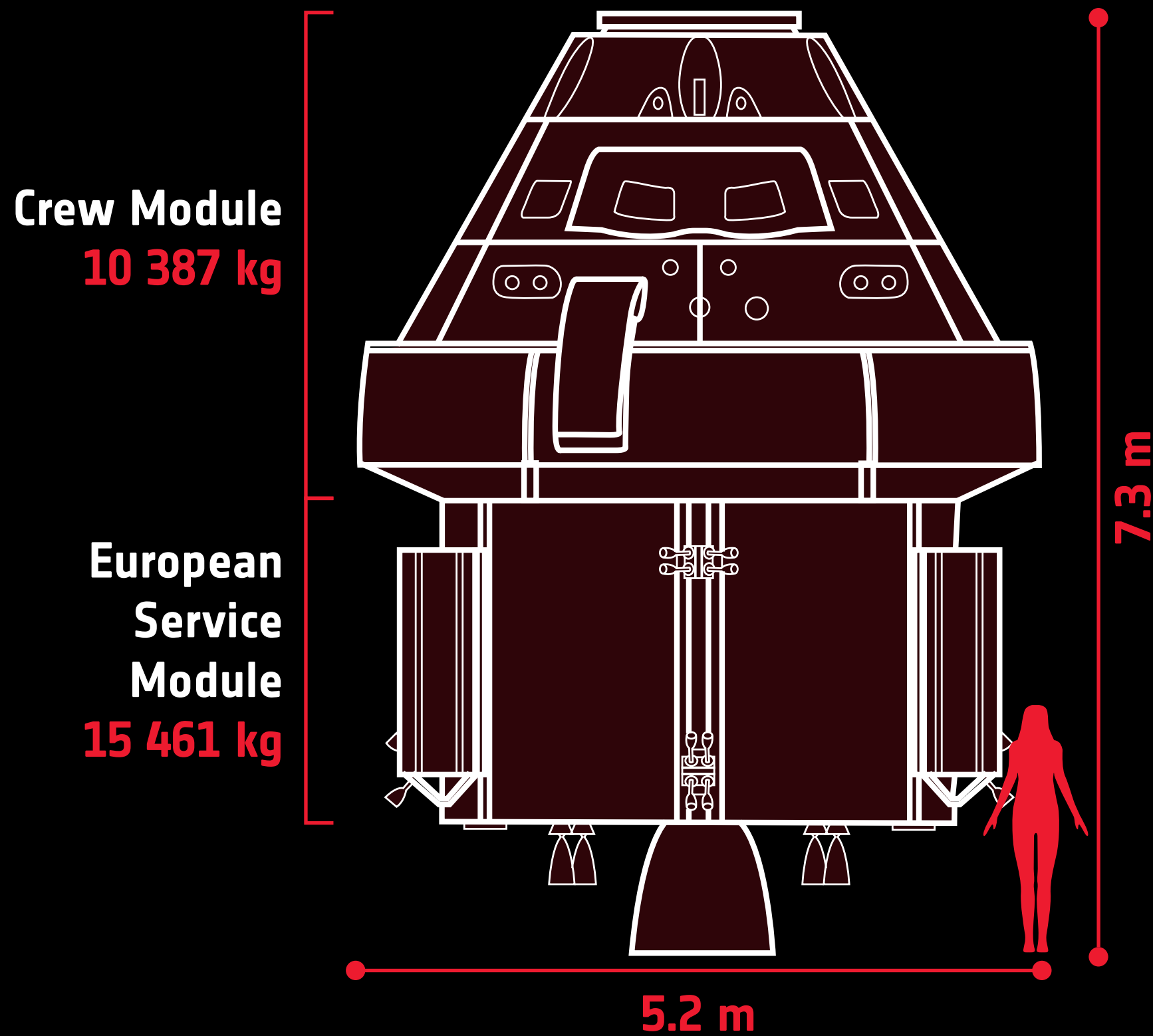
Orion will be launched by NASA's Space Launch System – the most powerful rocket ever built. The heavy-lift rocket will allow Orion to break free of Earth's gravity to explore our Solar System.

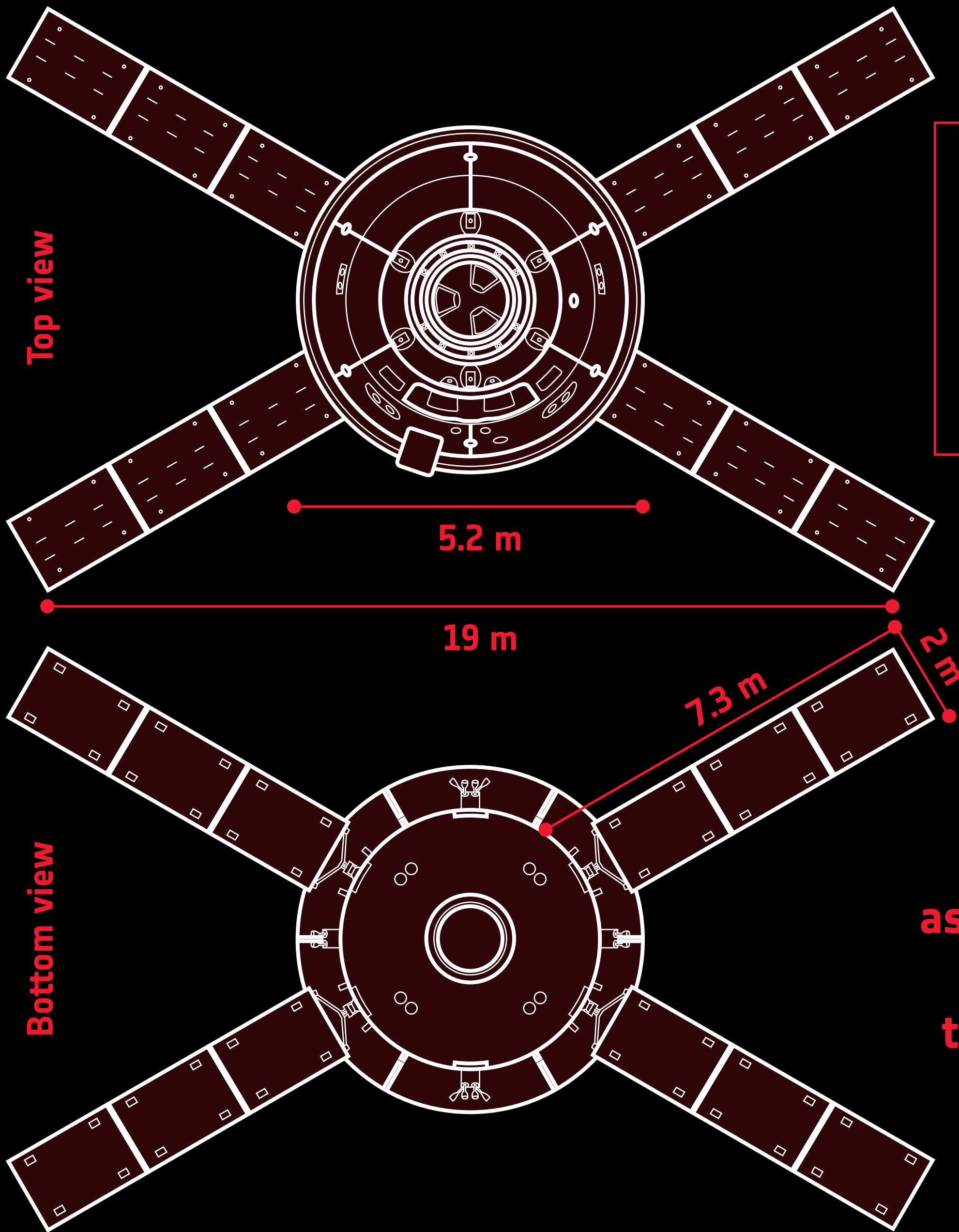


#ForwardToTheMoon

→ ORION

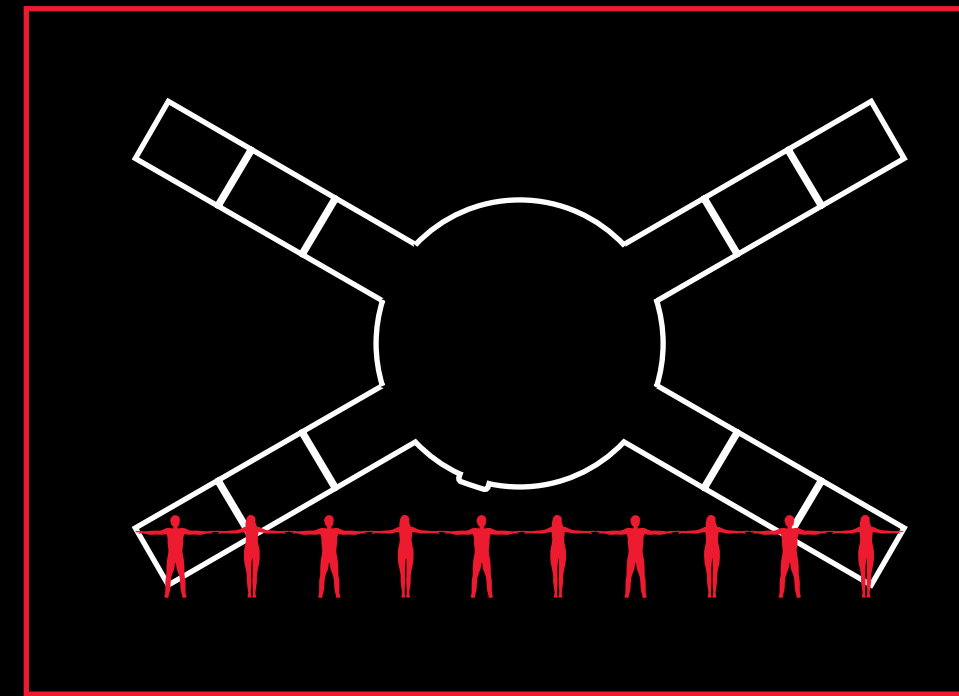
Dimensions





Top view

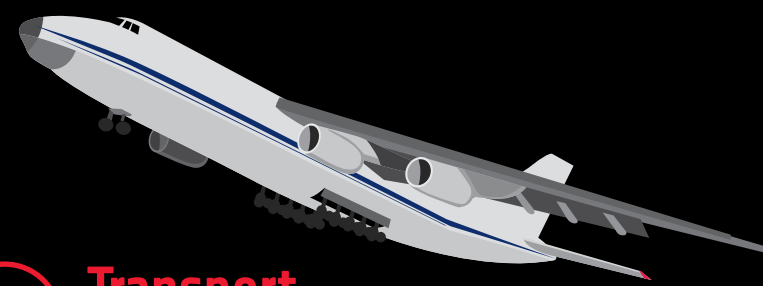
Bottom view



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

→ **ORION**

The journey



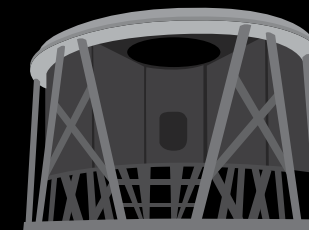
4 Celebration
European Service Module and Crew Module Adapter connected

3 Transport
Service Module and solar arrays transported from Germany to USA

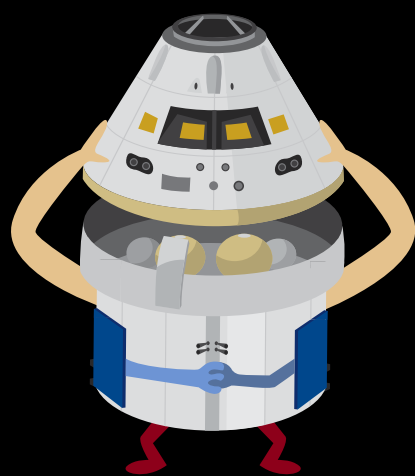
2 Assembly
The European Service Module is assembled in Germany



1 Structure
The European Service Module structure is built in Italy

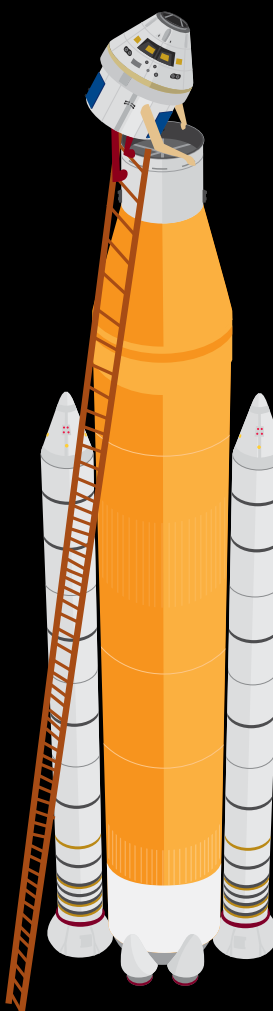


5 Assembly
Complete Orion Service Module and Crew Module at NASA's Kennedy Space Center, Florida

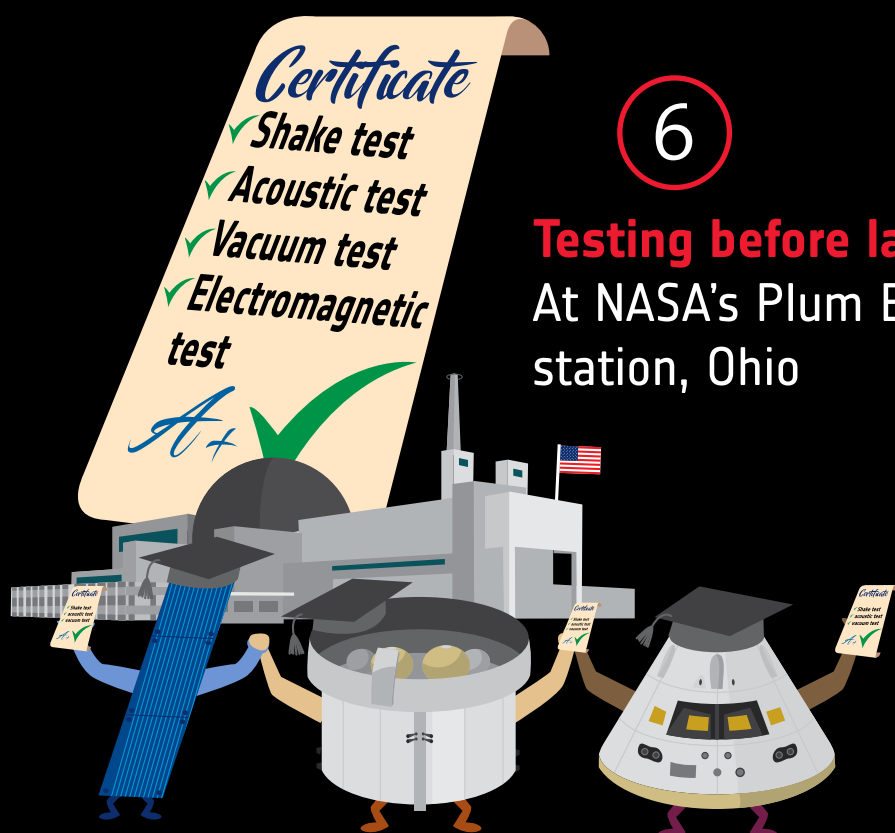


6 Testing before launch
At NASA's Plum Brook station, Ohio

7 Rocket integration



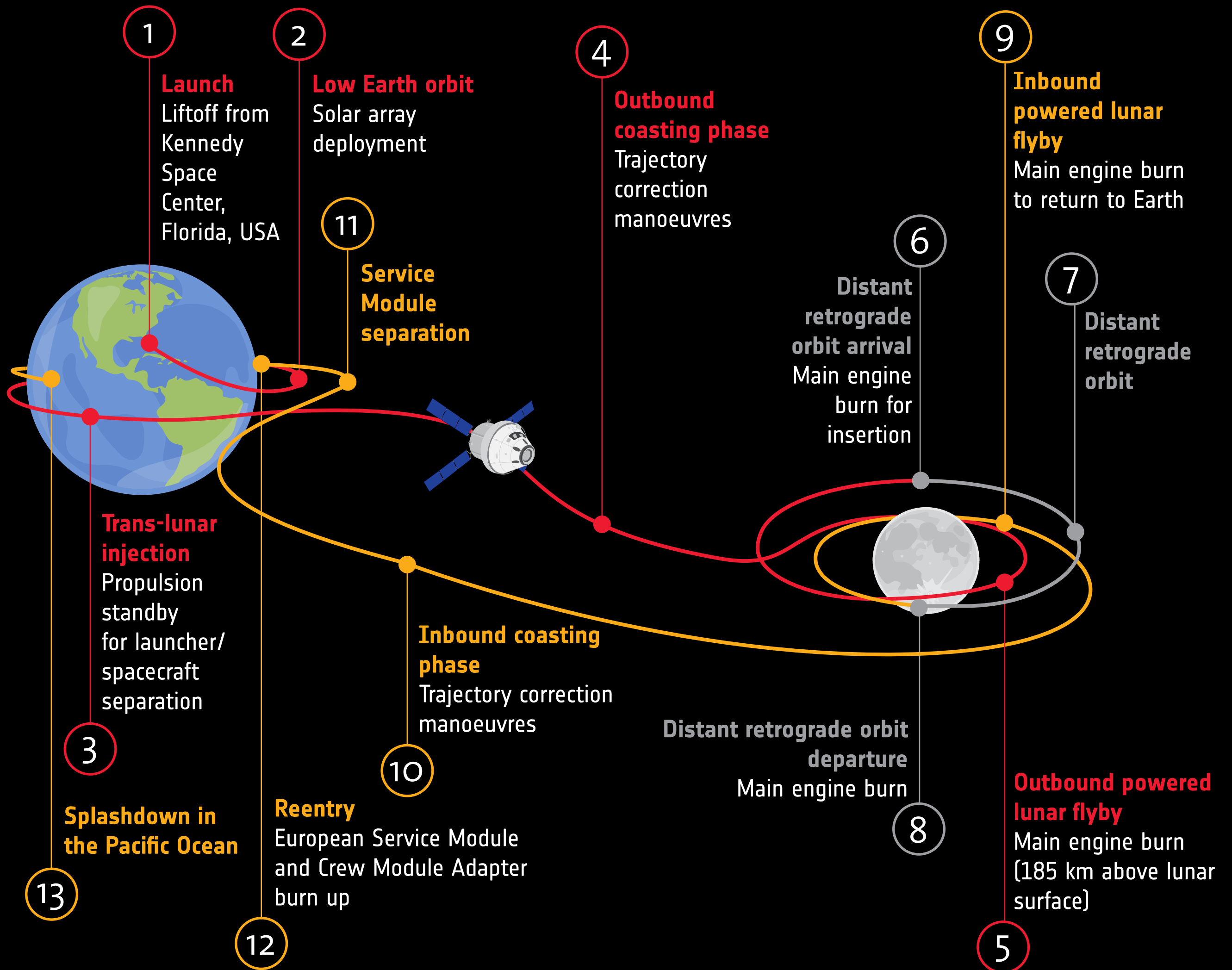
8 Liftoff!



#ForwardToTheMoon

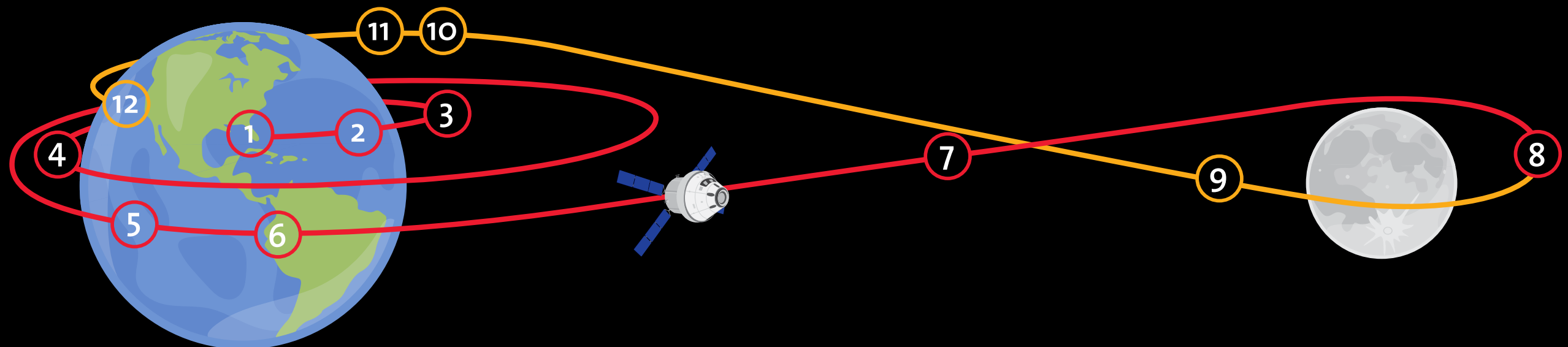
→ ORION

Artemis 1 step-by-step



→ ORION

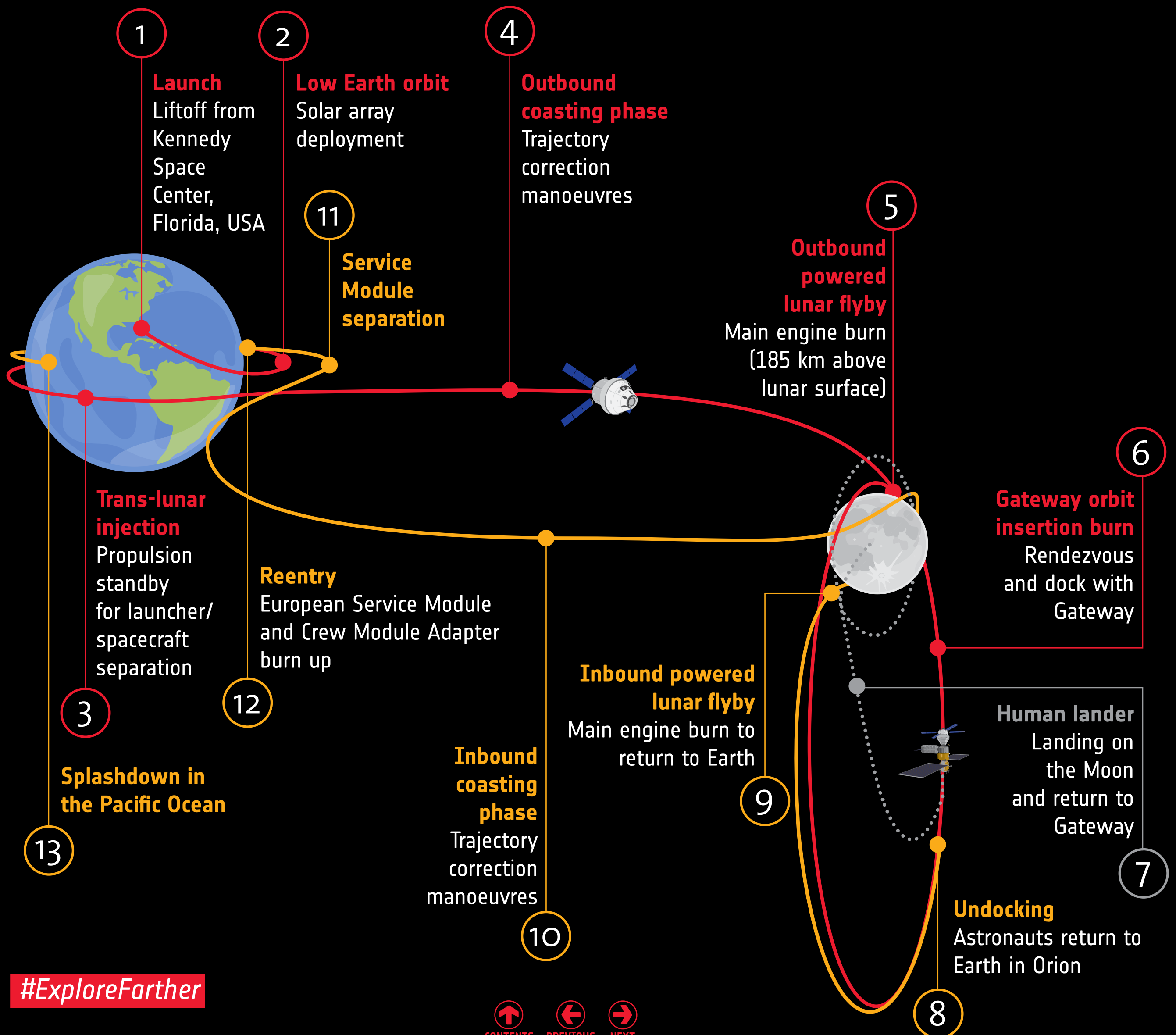
Artemis 2 step-by-step



- 1 Liftoff**
Kennedy Space Center, Florida, USA
- 2 Low Earth Orbit**
European Service Module deploys solar arrays
- 3 Perigee Raise Manoeuvre**
Interim Cryogenic Propulsion propels Orion to a higher orbit
- 4 Apogee Raise Burn**
Second burn to high Earth orbit for 42-hour system checkout
- 5 Separation**
Interim Cryogenic Propulsion System separates from Orion
- 6 Translunar injection**
Orion's European Service Module main engine fires to propel the spacecraft to the Moon
- 7 Outbound coasting phase**
Four-day trip to lunar orbit with European Service Module correcting as necessary
- 8 Lunar flyby**
7500 km from the Moon's surface
- 9 Return to Earth**
Four-day trip with Return Trajectory Corrections supplied by Orion's European Service Module auxiliary engines
- 10 Service Module separation**
European Service Module and Crew Module Adapter separate from Crew Module
- 11 Crew Module Reentry**
European Service Module and Crew Module Adapter burn up
- 12 Splashdown**
Pacific Ocean

→ **ORION**

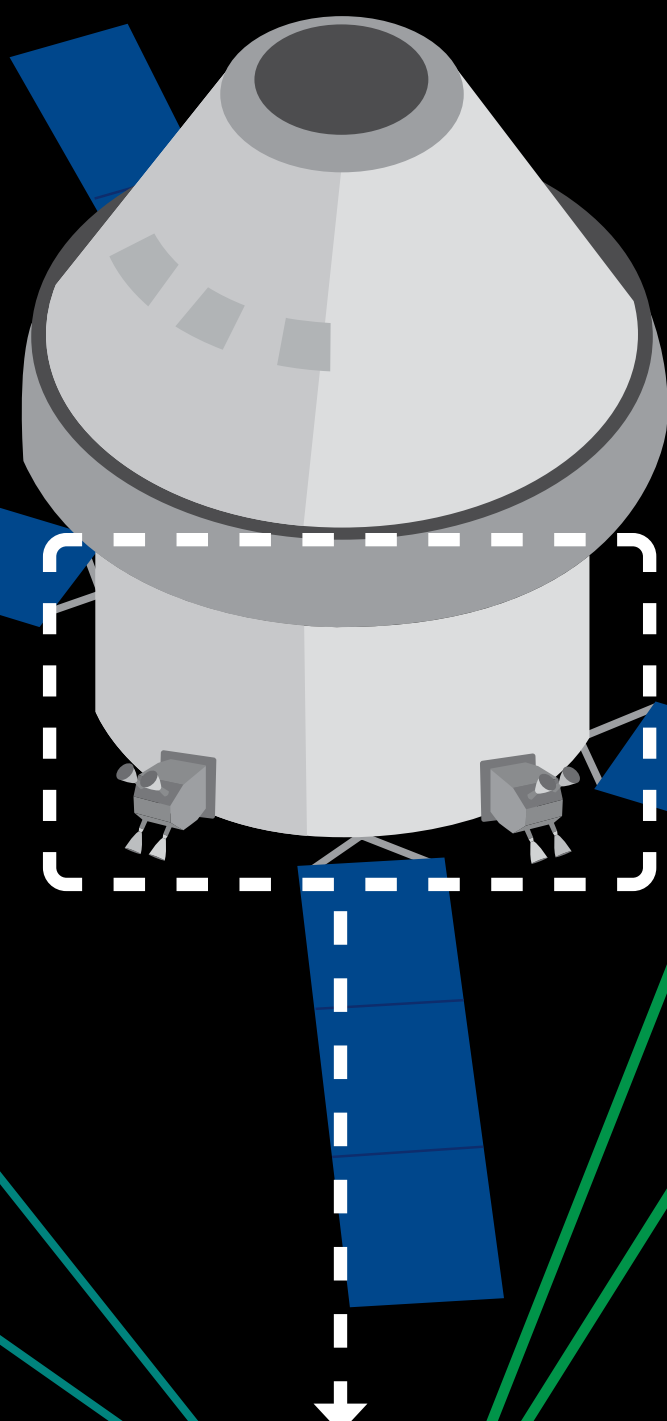
Artemis 3 step-by-step



#ExploreFarther

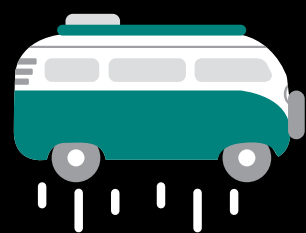
→ ORION

The European powerhouse



Propulsion system

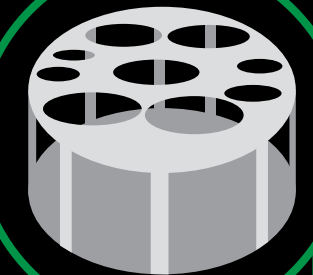
Main engine has enough thrust to **lift a van on Earth.**



Four tanks hold 8000 litres of fuel, enough to fill **200 cars with fuel.**

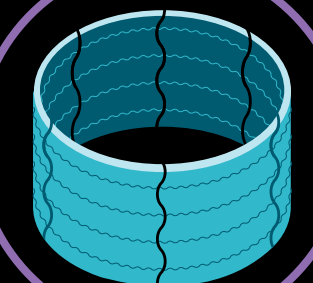
Structure

Like the chassis of a car, **the structure** holds everything together.



Thermal control system

Heaters and coolant pumped through six radiators keep Orion running warm despite space temperatures of **-75°C to +90°C.**



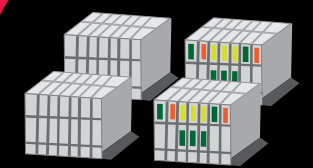
Consumables

Supplies enough water and air for up to **four astronauts** on a 20-day mission.



Avionics

The brain: computers control all aspects of the European Service Module. Over **11 km of cables** to send commands and receive information from sensors.



Solar arrays

Provides enough electricity for **two households.**



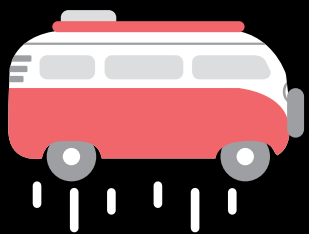
→ ORION

Propulsion

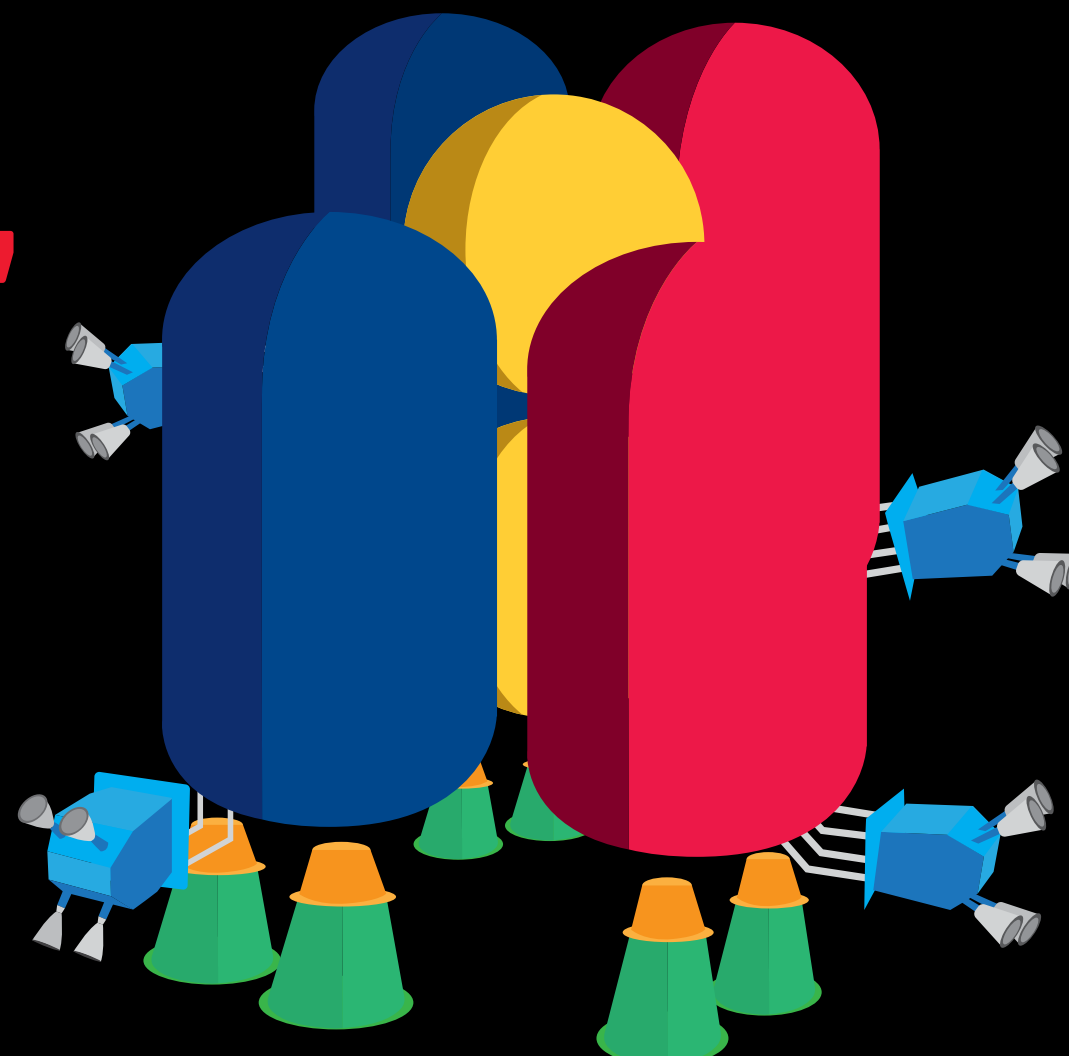
Orion relies on the engines of ESA's European Service Module to navigate and orient itself in space. The engines can be fired individually to move the spacecraft and rotate it to any position.

33 engines, 3 types

- Main engine has enough thrust to **lift a van on Earth**

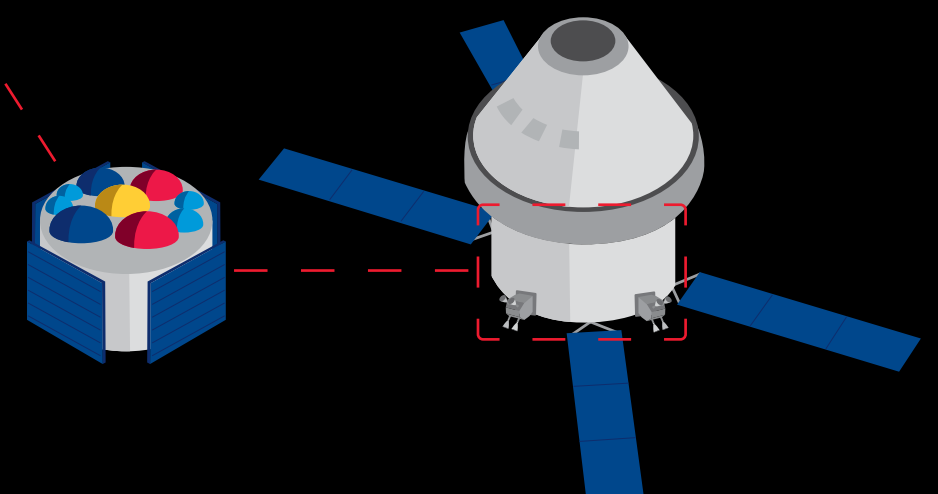


- Eight backup thrusters **can lift 50 kg** each on Earth
- **24 smaller engines** provide attitude control



Fuel

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

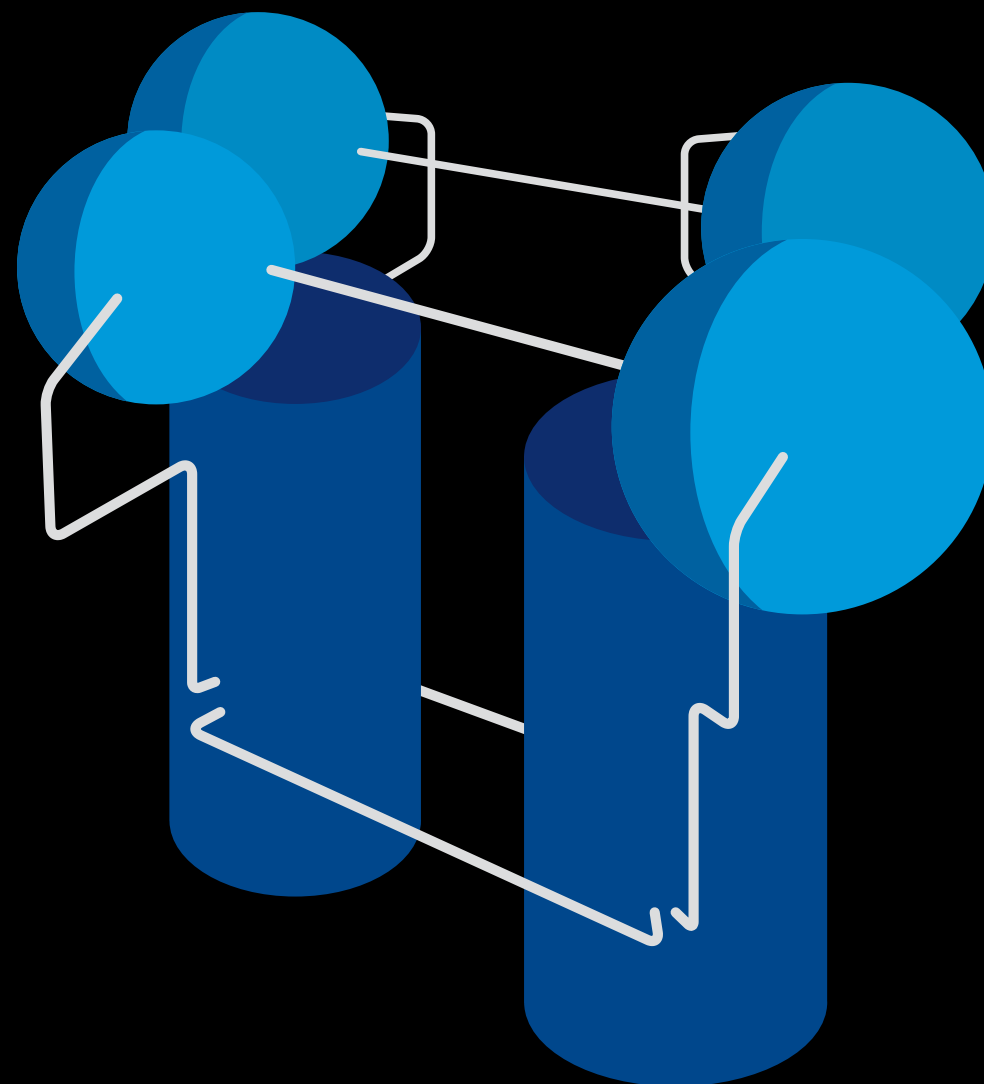


→ **ORION**

Air and water

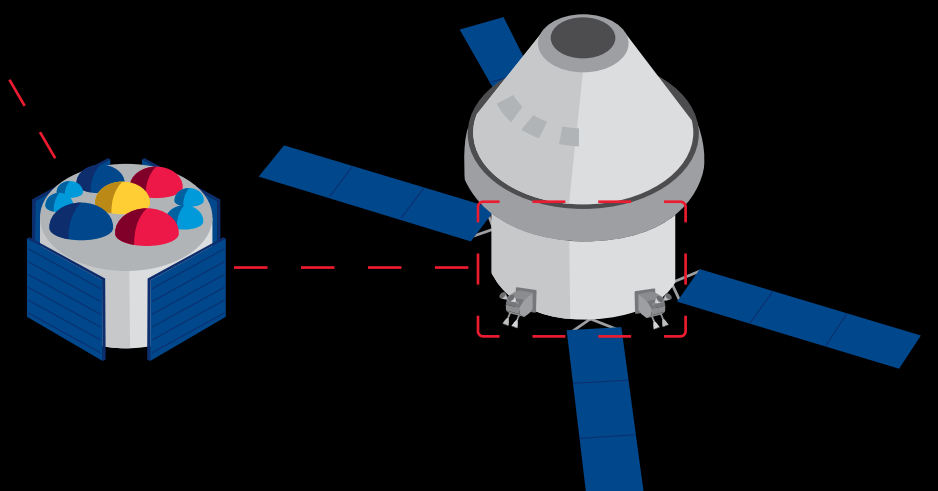
The European Service Module provides air and water for the astronauts in the Orion spacecraft. The oxygen and nitrogen are stored separately, and mixed into the Crew Module for the astronauts to breathe.

240 litres
of potable water



30 kg of
nitrogen
and 90 kg of
oxygen

Enough to keep
four astronauts
alive on a 20-day mission



→ ORION

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

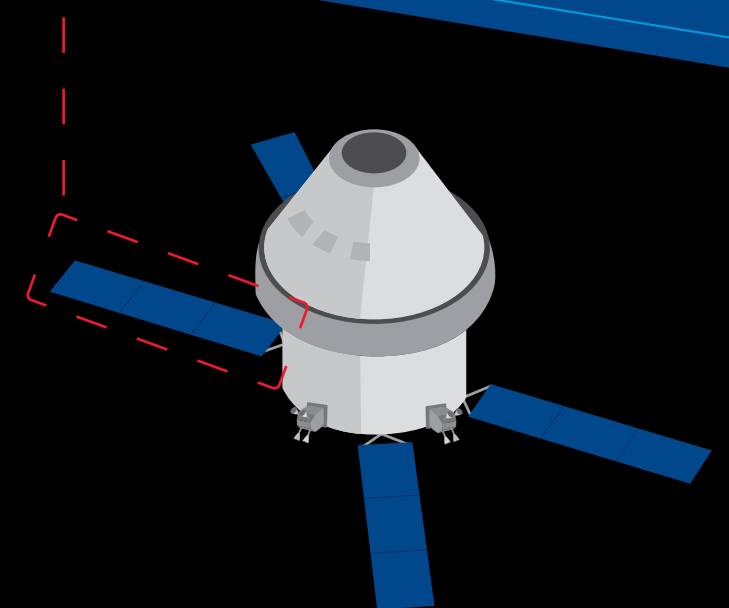
Wing length:
7 m

Solar array span:
19 m

Can swivel and rotate to
follow the Sun



Provides enough electricity for
two households: 11.2 kW

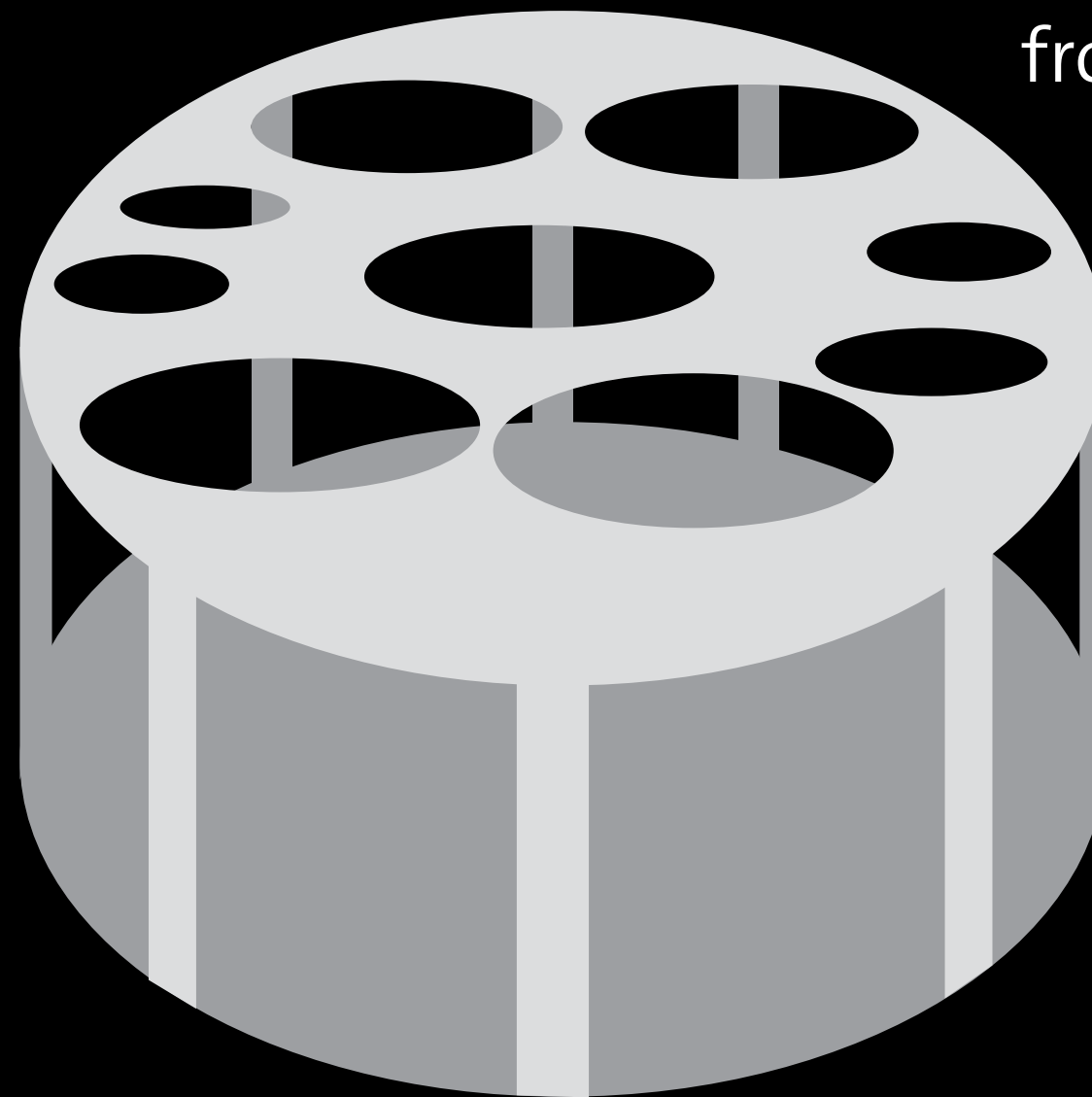


→ ORION

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 together**

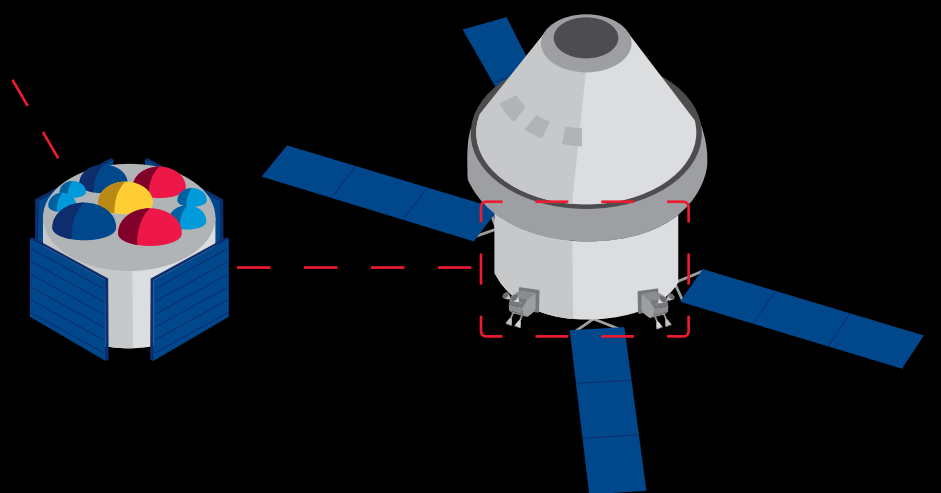


Absorbs vibrations

from launch – similar to the thrust of 34 Jumbo Jets

Covered with Kevlar

to absorb shocks from micrometeorites and debris impacts

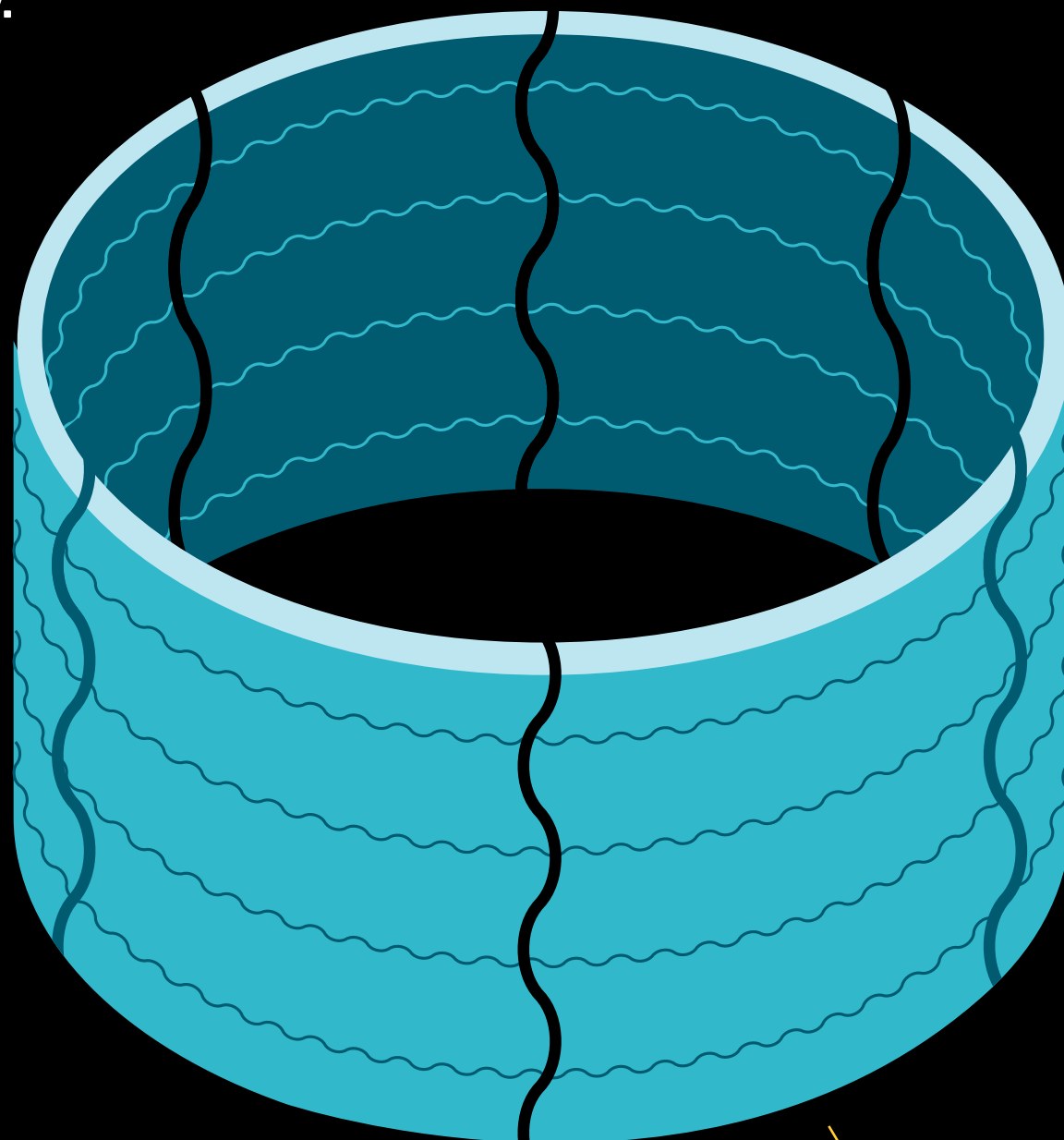





→ ORION

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.

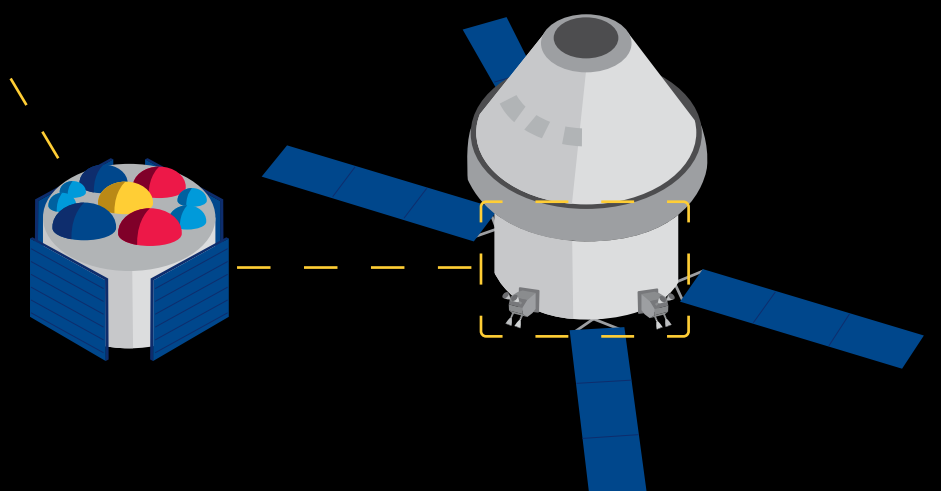
Six radiators
outside the Service Module



   Coolant is **pumped** in a closed circuit, similar to a car

Coolant:
hydrofluoroether

Insulation:
multi-layer insulation blankets

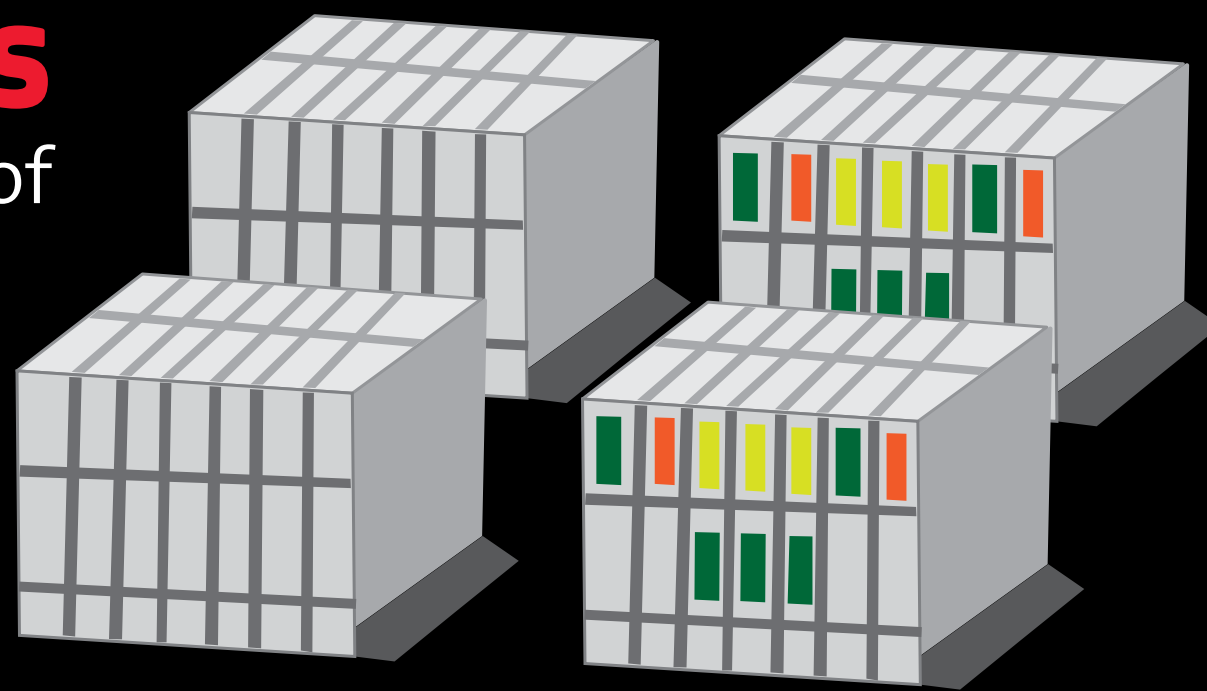


→ ORION

Avionics

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

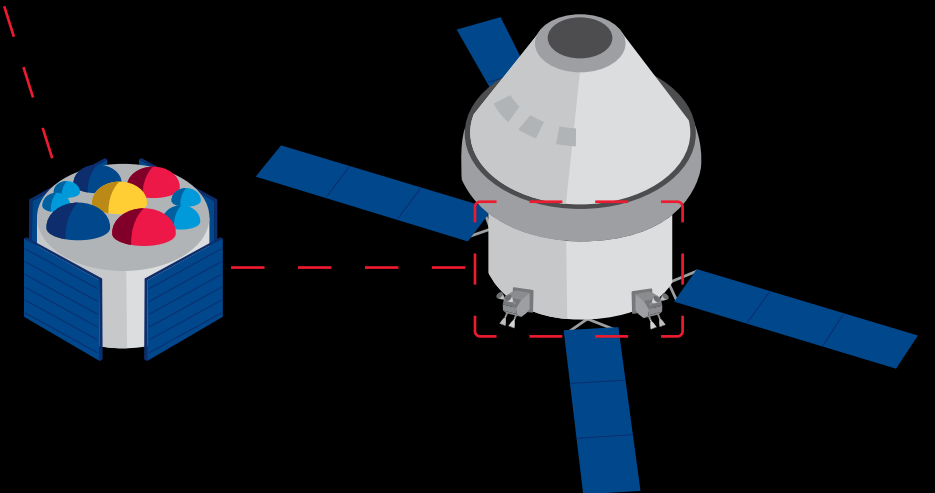
Computers control all aspects of the service module.



Fly-by-wire: automatically regulates propulsion, water, electronics and temperature.

Over 11 km of cables

send commands and receive information from sensors.



→ ORION

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

- Tank bulkhead
- Electrical ground support equipment
- Pressure regulation units

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

- Electronics
- Electrical ground support equipment

Sweden

- Propulsion Qualification Module integration

Norway

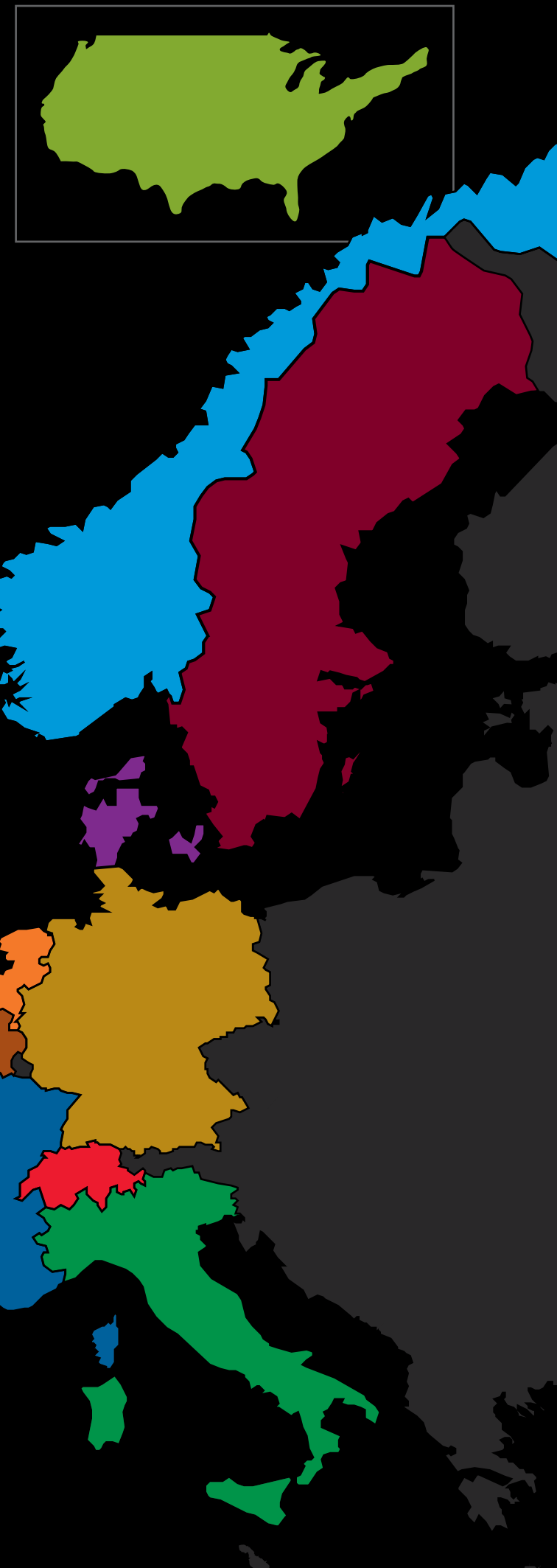
- Hydrophobic filter

The Netherlands

- Solar array wings

Spain

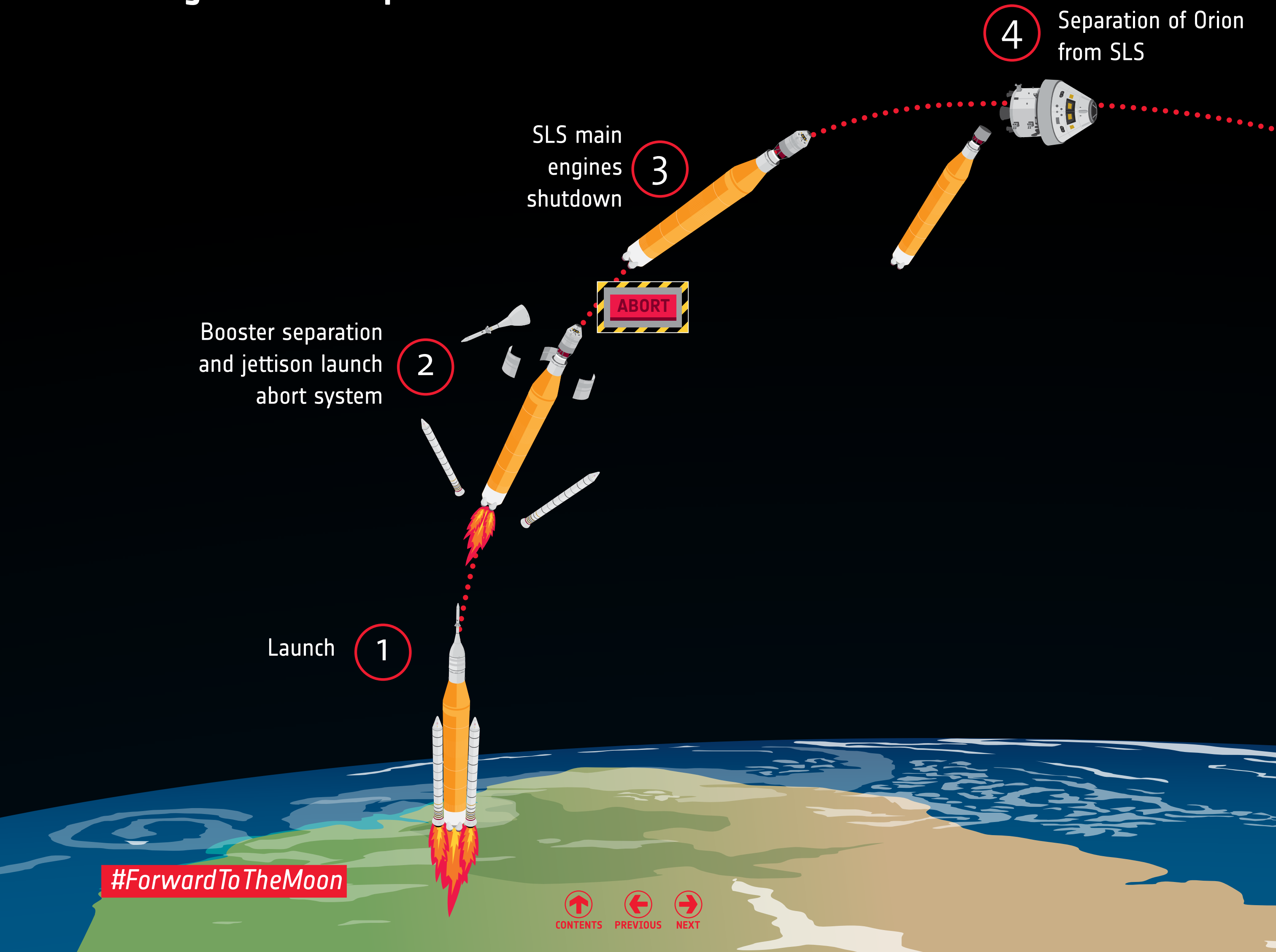
- Thermal control unit



orion

→ ABORT SCENARIOS USING THE EUROPEAN SERVICE MODULE

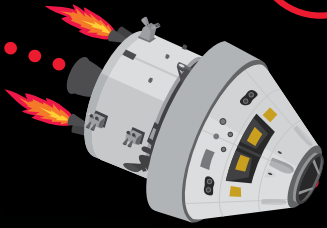
Untargeted abort splashdown



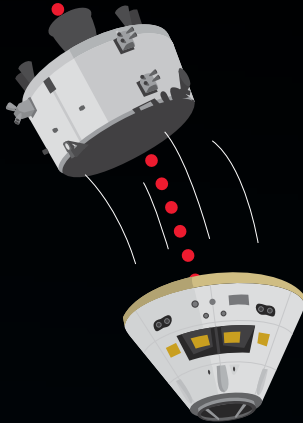
#ForwardToTheMoon



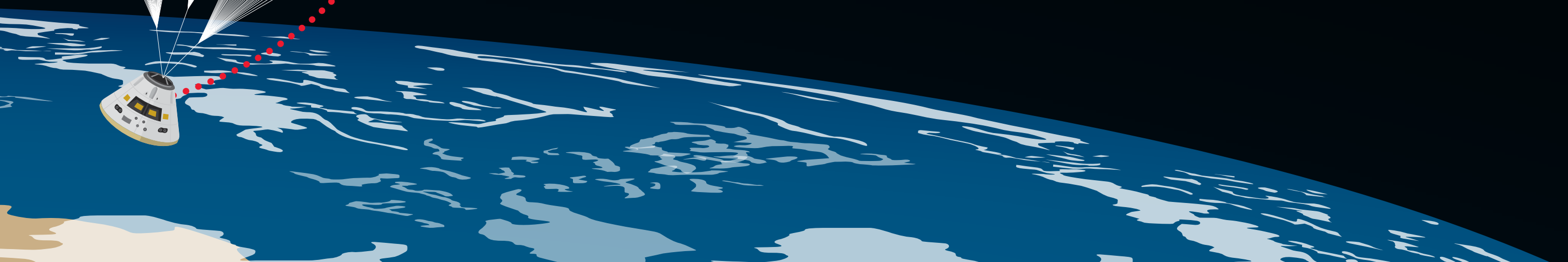
5 Auxiliary thrusters fire to further separate Orion from launcher



6 Capsule separation



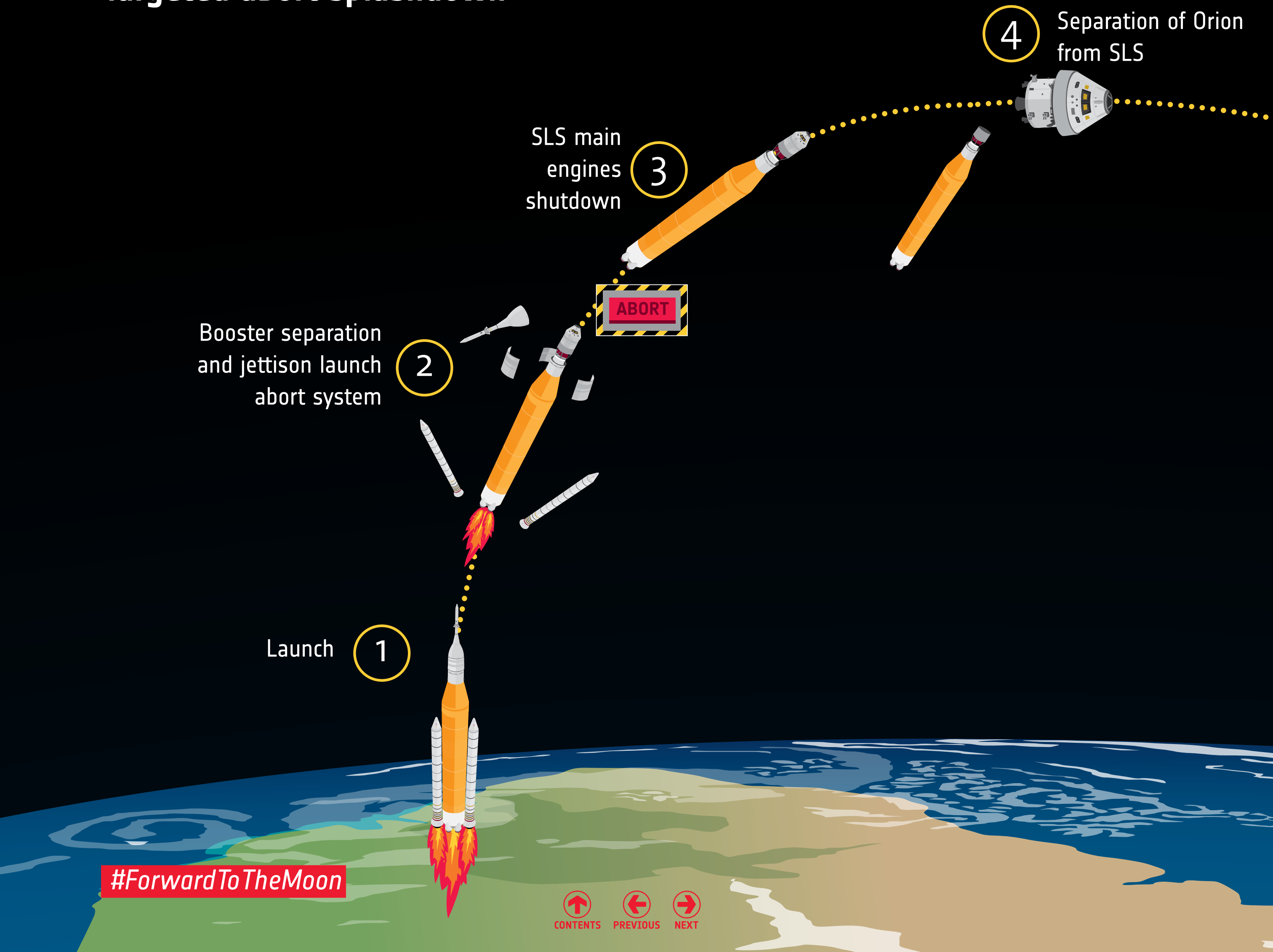
7 Capsule orientation and landing



orion

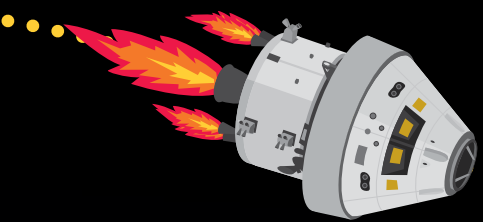
→ ABORT SCENARIOS USING THE EUROPEAN SERVICE MODULE

Targeted abort splashdown





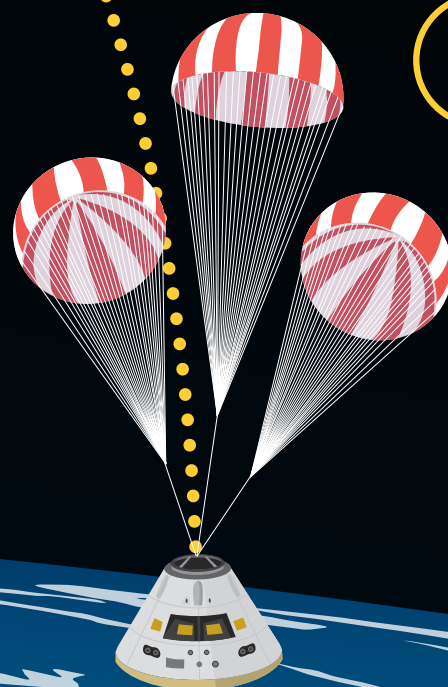
5 Firing of main and auxiliary engines to target a landing zone for splashdown



6 Capsule separation



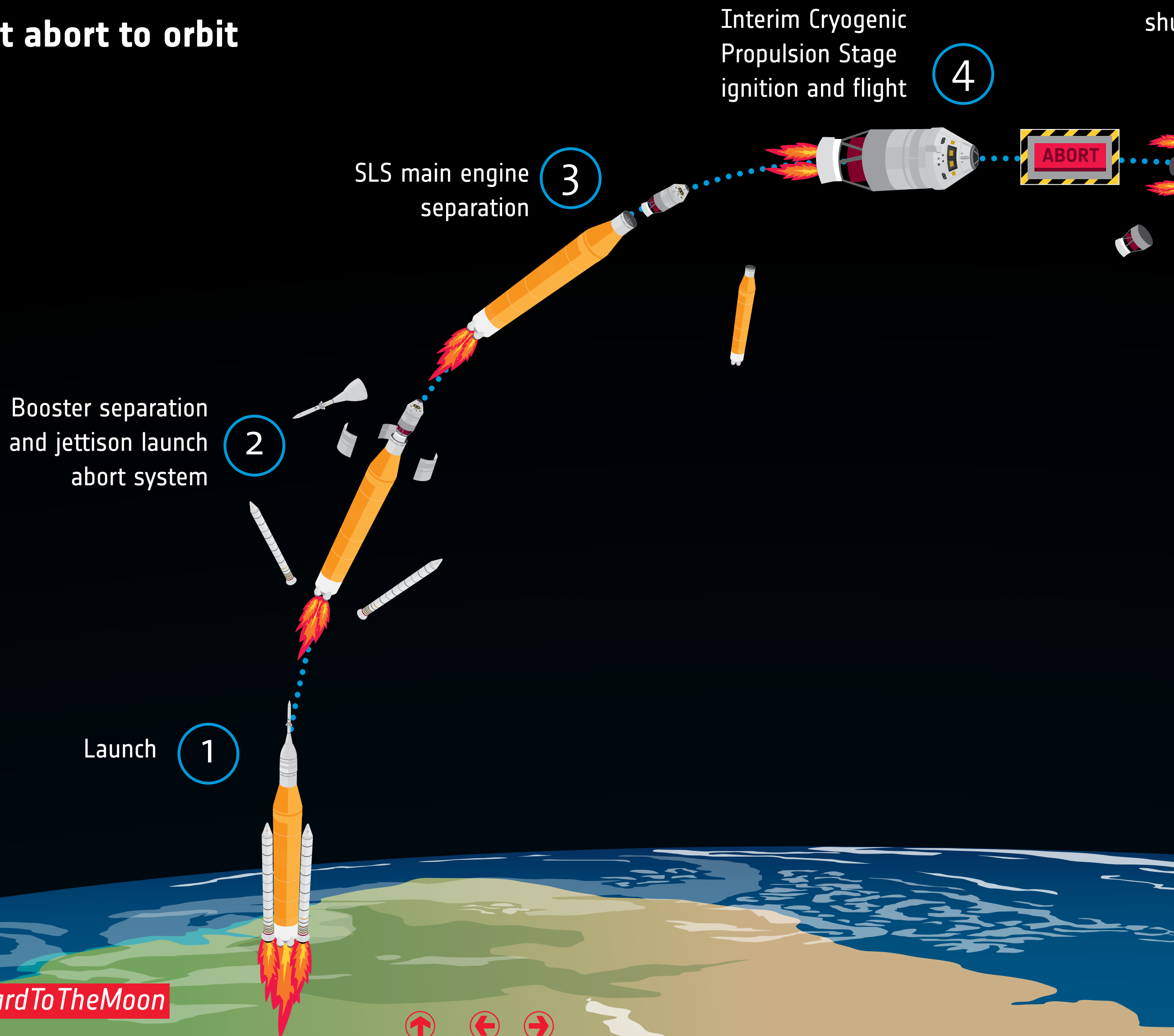
7 Capsule orientation and landing



orion

→ ABORT SCENARIOS USING THE EUROPEAN SERVICE MODULE

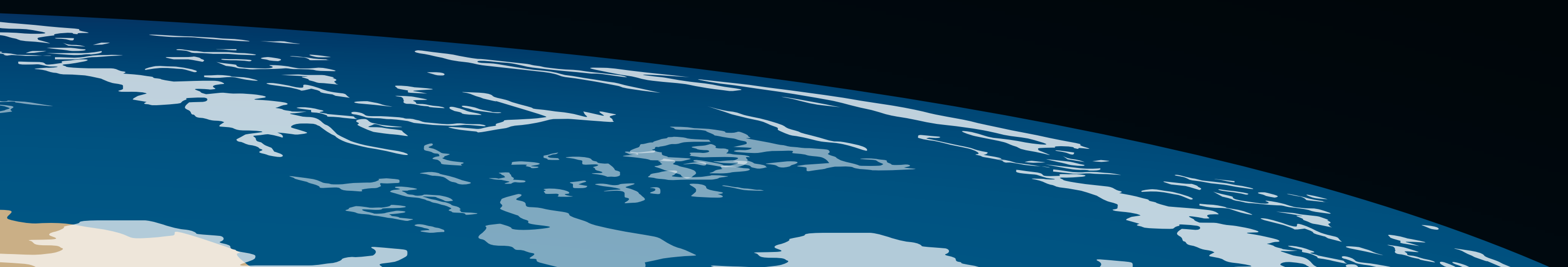
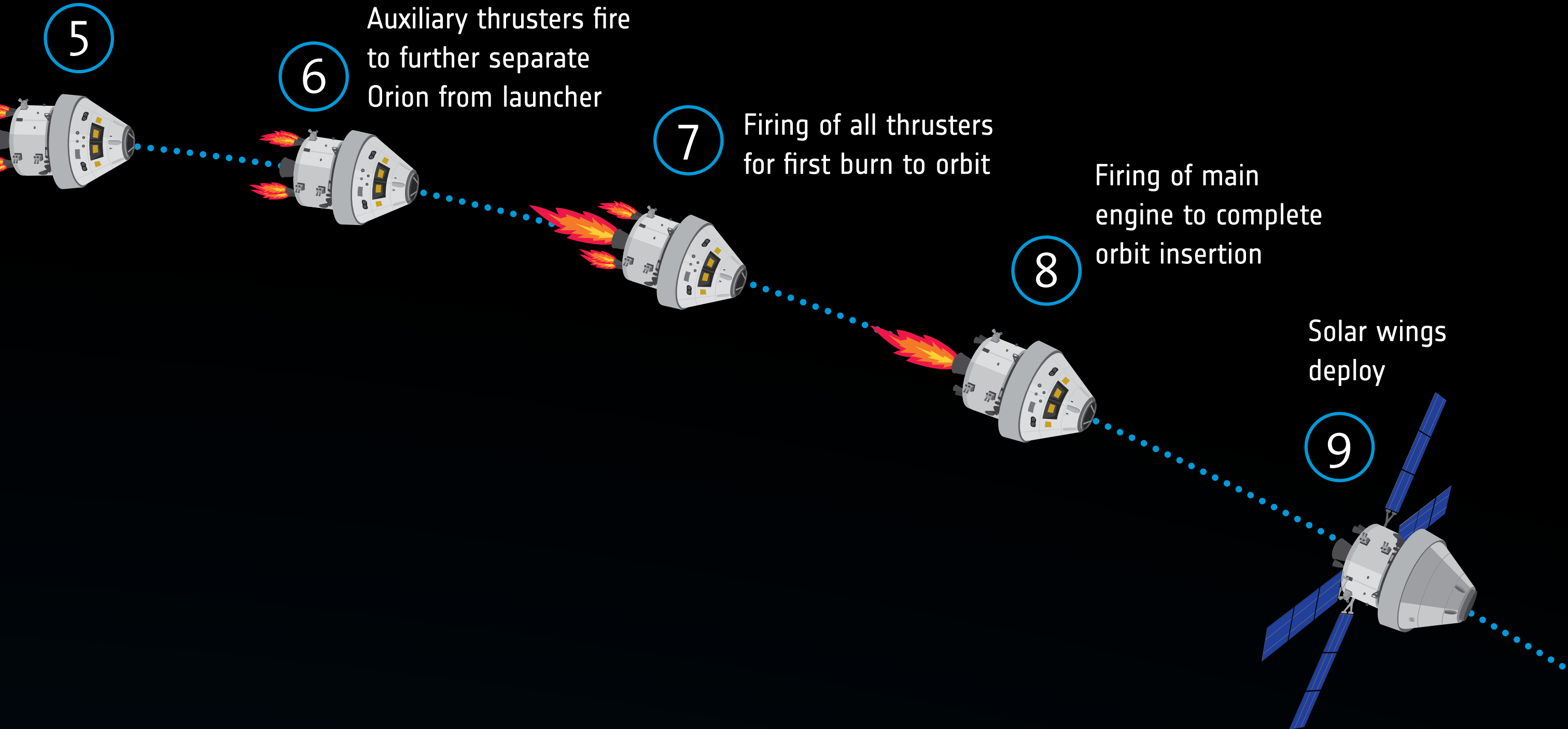
Ascent abort to orbit



#ForwardToTheMoon

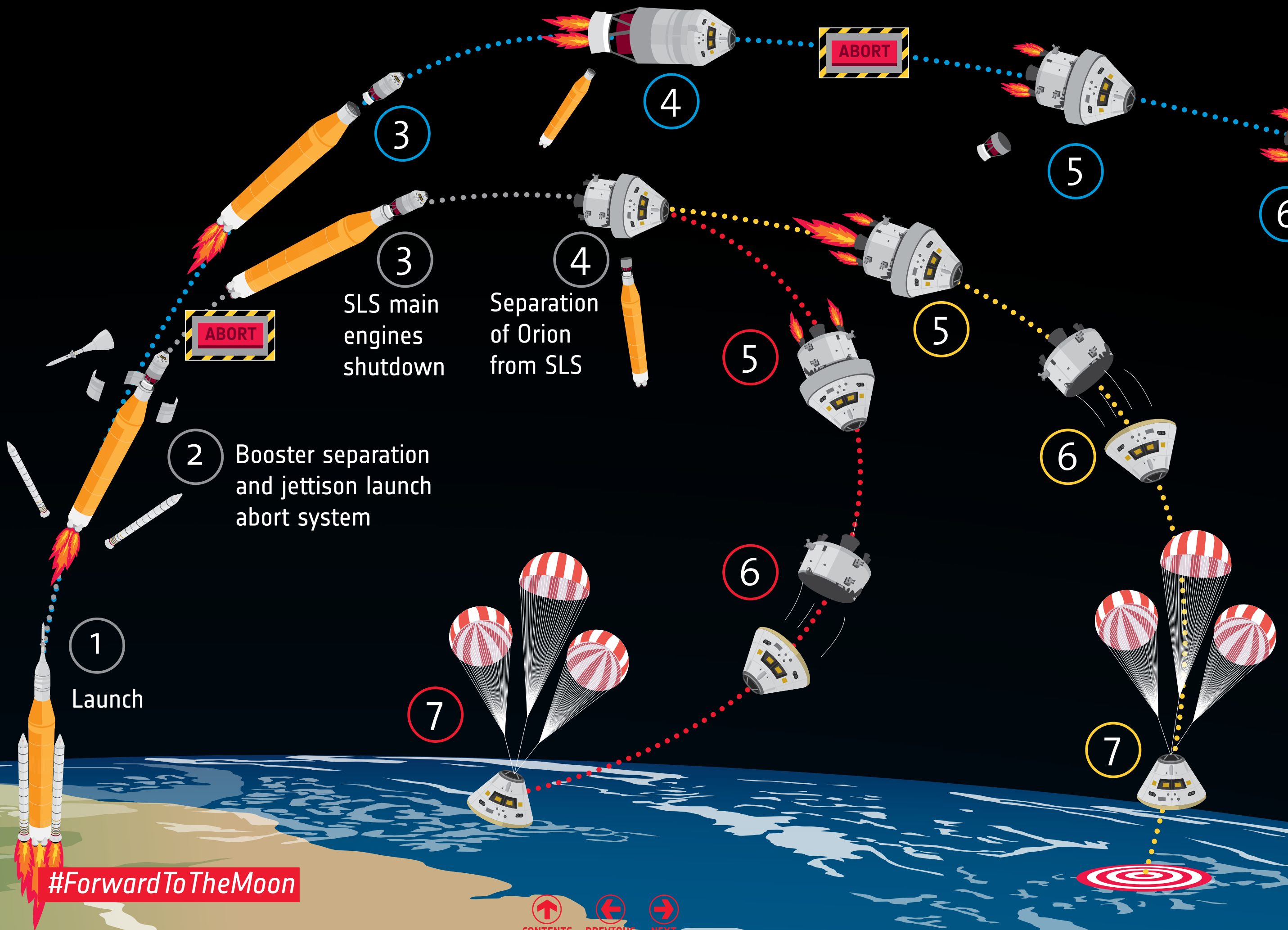


Merim Cryogenic
propulsion Stage
shutdown and separation



orion

→ ABORT SCENARIOS USING THE EUROPEAN SERVICE MODULE



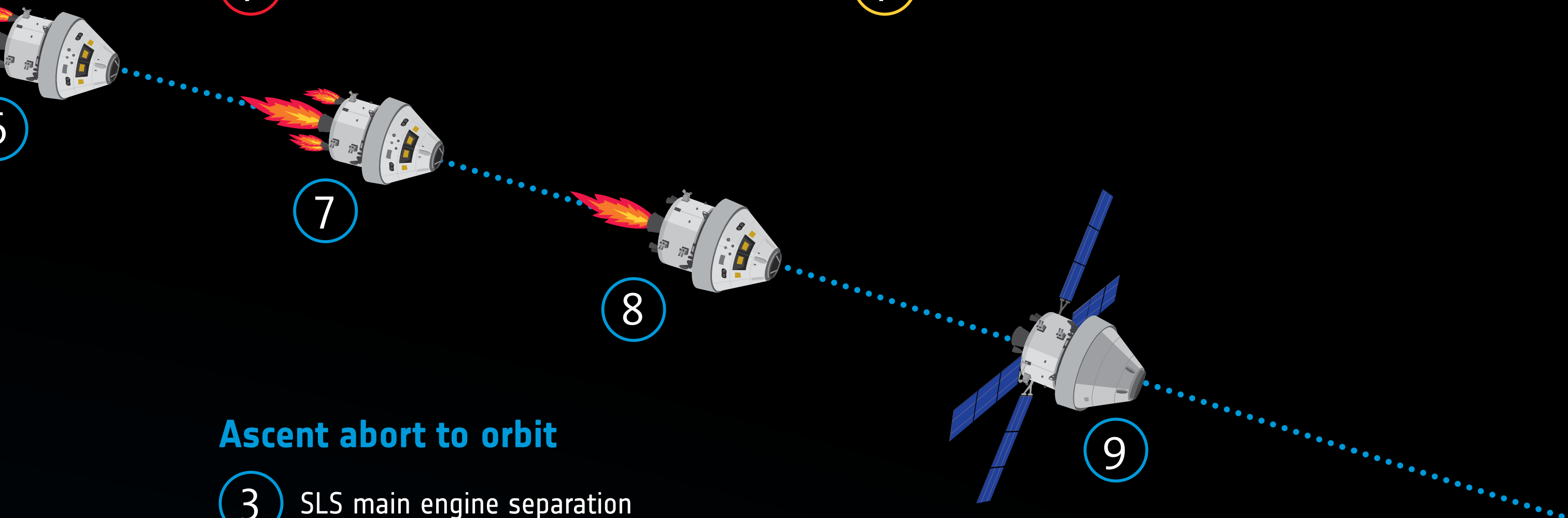


Untargeted abort splashdown

- 5 Auxiliary thrusters fire to further separate Orion from launcher
- 6 Capsule separation
- 7 Capsule orientation and landing

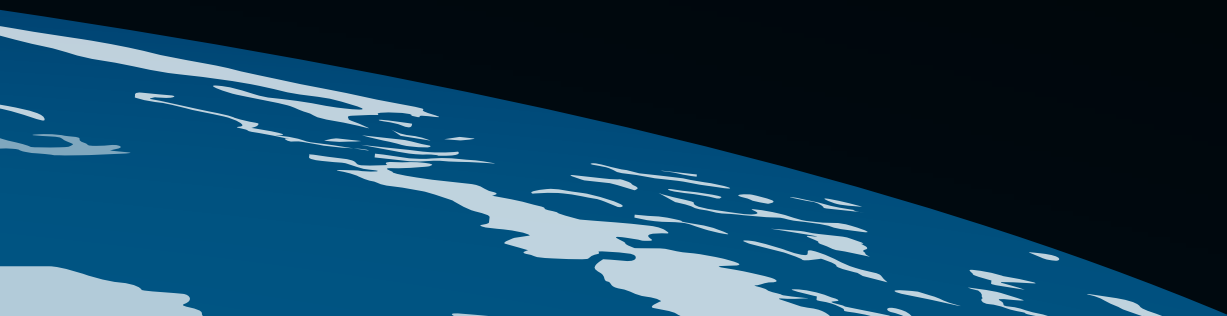
Targeted abort splashdown

- 5 Firing of main and auxiliary engines to target a landing zone for splashdown
- 6 Capsule separation
- 7 Capsule orientation and landing

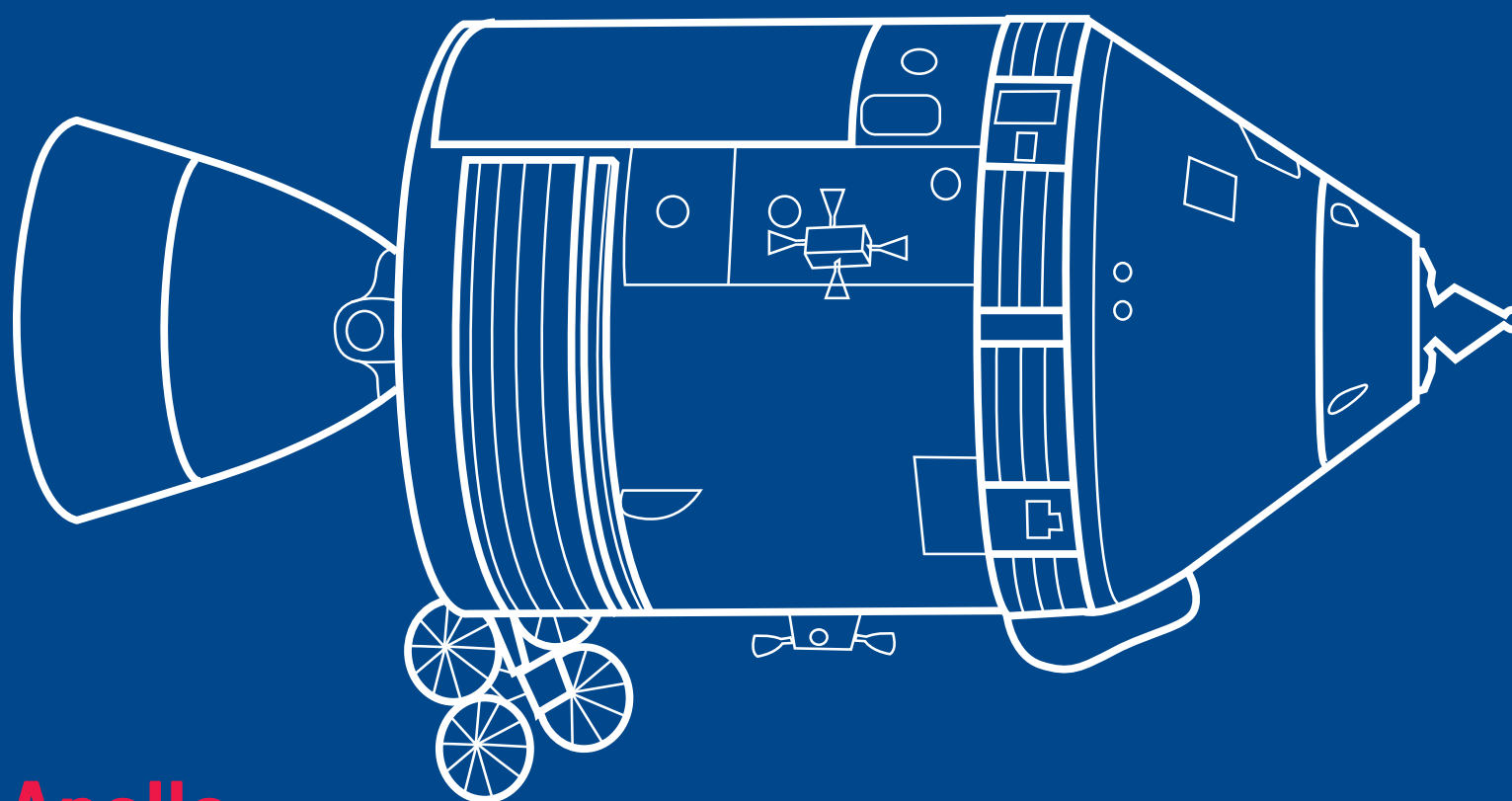
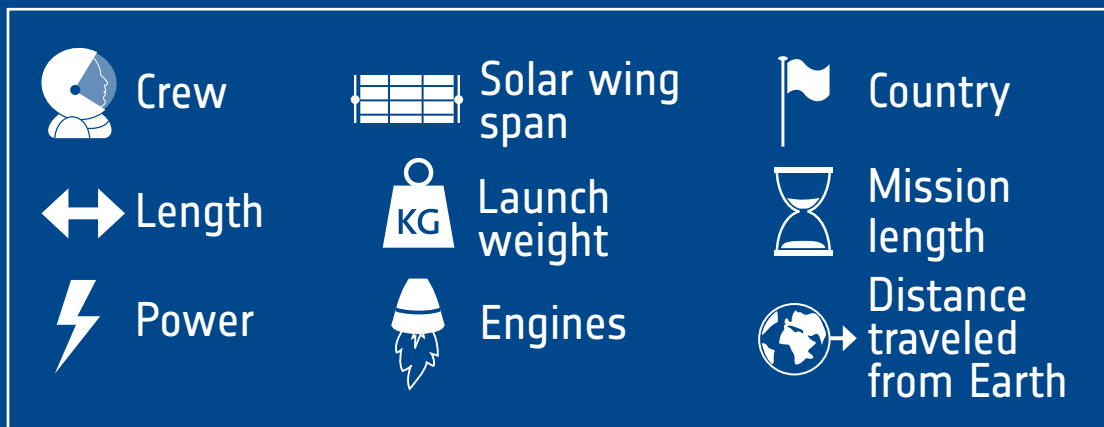


Ascent abort to orbit

- 3 SLS main engine separation
- 4 Interim Cryogenic Propulsion Stage ignition and flight
- 5 Interim Cryogenic Propulsion Stage shutdown and separation
- 6 Auxiliary thrusters fire to further separate Orion from launcher
- 7 Firing of all thrusters for first burn to orbit
- 8 Firing of main engine to complete orbit insertion
- 9 Solar wings deploy

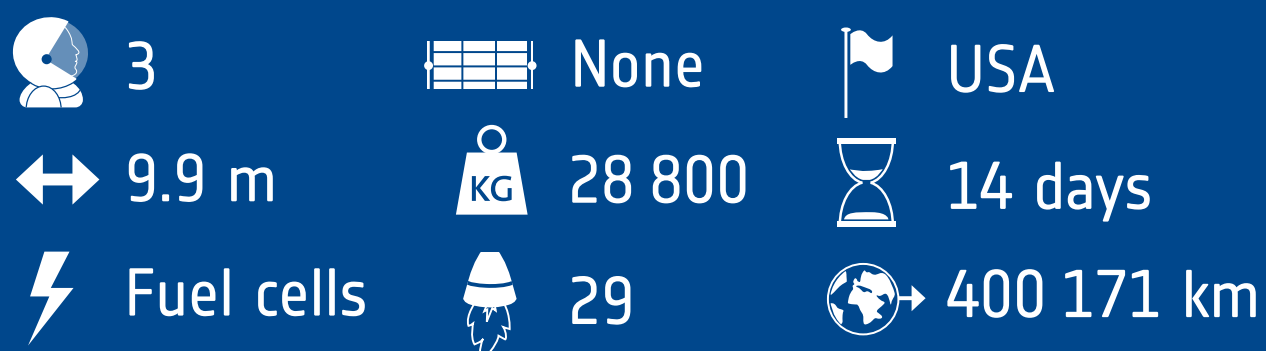


→ APOLLO – AUTOMATED TRANSFER VEHICLE – ORION



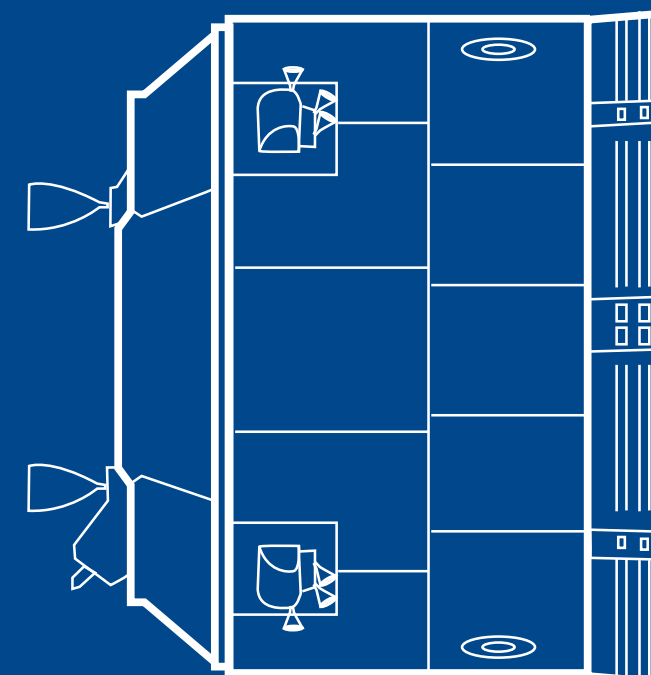
Apollo

The Apollo spacecraft carried the first people to the Moon over 50 years ago. A complete lunar landing mission configuration was composed of the Apollo Command and Service Modules, plus a Lunar Module. The Command Module housed the crew and Service Module provided the propulsion for the lunar orbit insertion and trans-Earth burn for the return to Earth.



Automated Transfer Vehicle

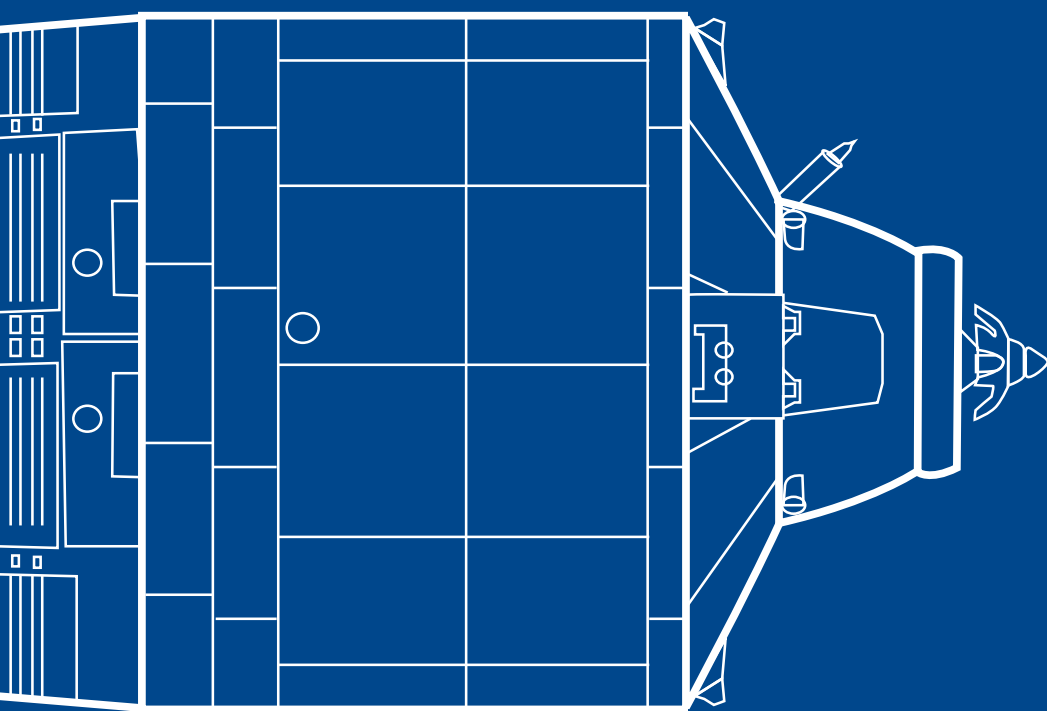
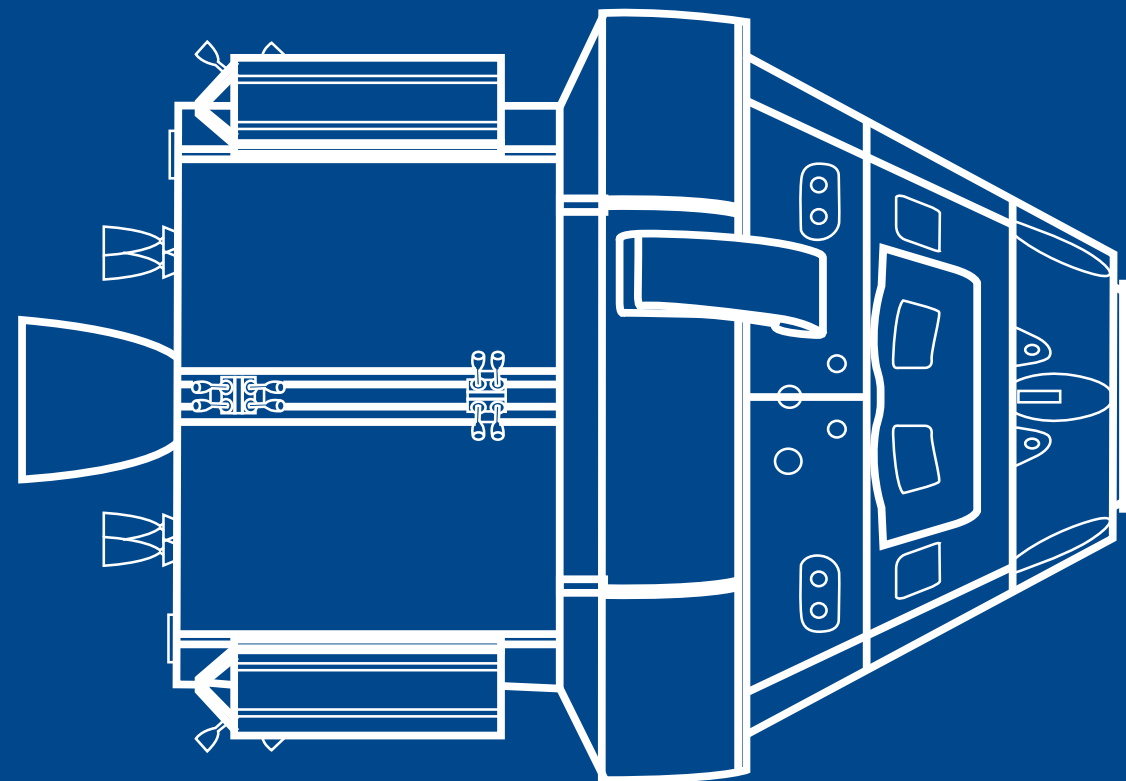
Five Automated Transfer Vehicles will be used to deliver supplies over the course of the mission. The ATV will be launched from the Space Station from 2008 and will be used to raise its orbit numerous times to avoid the way of space debris.



Transfer Vehicle

Transfer Vehicles delivered more than 31 500 kg of cargo on the course of their missions to the International Space Station from 1998 to 2015. They boosted the Station to higher orbits and similarly moved it out of the way of other spacecraft.

- 22.3 m
- 10 European countries
- 20 750 kg
- 6 months
- 32
- 400 km



Orion

Orion is NASA's next spacecraft to send humans into deep space. It is designed to send astronauts farther into space than ever before, beyond the Moon and to asteroids. ESA has designed and is overseeing the development of the European Service Module, the part of the spacecraft that supplies air, electricity and propulsion.

- 4
- 19 m
- USA and 10 European countries
- 7.3 m
- 33 446 kg
- 21 days
- Solar arrays
- 33
- 500 000 km

Photos



Acoustic testing,
Structural Model



Vibration testing,
Structural Model



Structure delivery



Propulsion
Qualification Model



Working on
propulsion



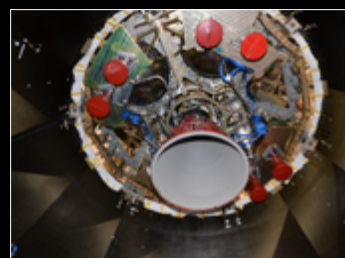
Test article



Test article
assembled



Test article with
Crew Module Adapter



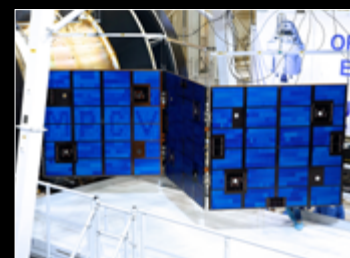
Inside a rocket's
belly



View from below



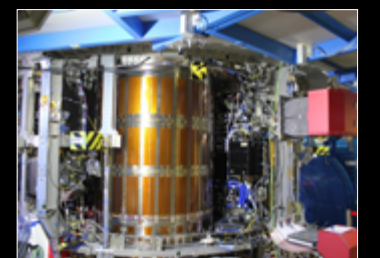
Waiting for the burn



Orion's wings



Fuel tank installation



Fuel tank



Radiator installation



Packing the European
Service Module



Packing the European
Service Module



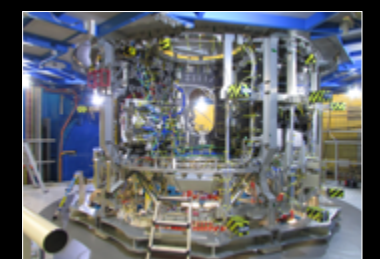
European Service
Module team



Moving the European
Service Module



Transport to Kennedy
Space Center



European Service
Module 2 assembly



Working on European
Service Module 2
engines



European Service
Module 2 tanks



First Orion complete



Orion in Plum Brook



Orion at Kennedy
Space Center

Graphics



Artemis logo



Artemis 1 insignia



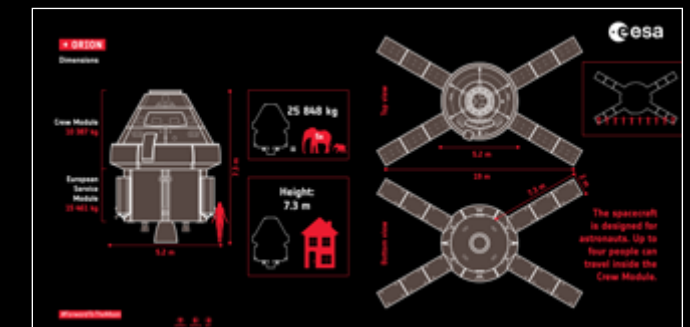
What is Orion



Orion the spacecraft



Orion the rocket



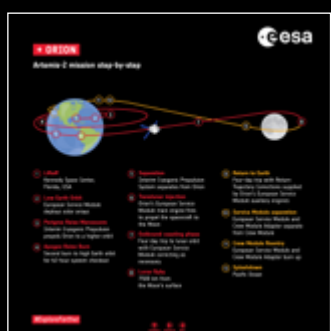
Orion dimensions



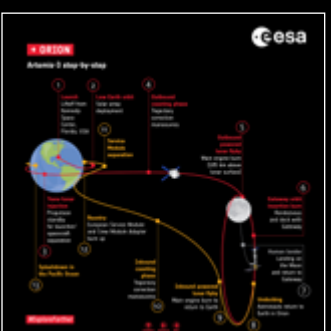
Orion the journey



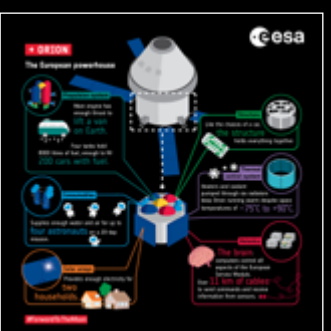
Artemis-1 step-by-step



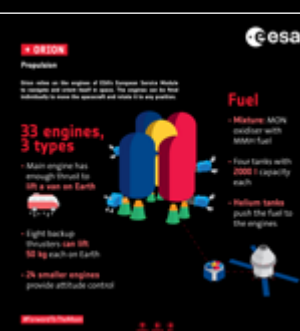
Artemis-2 step-by-step



Artemis-3 step-by-step



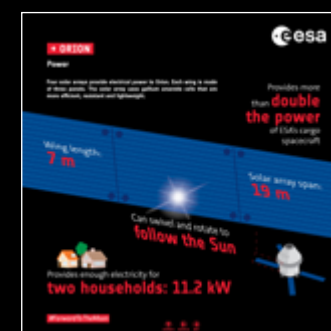
The European powerhouse



Orion propulsion



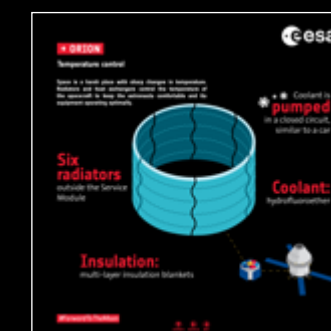
Orion air and water



Orion power



Orion structure



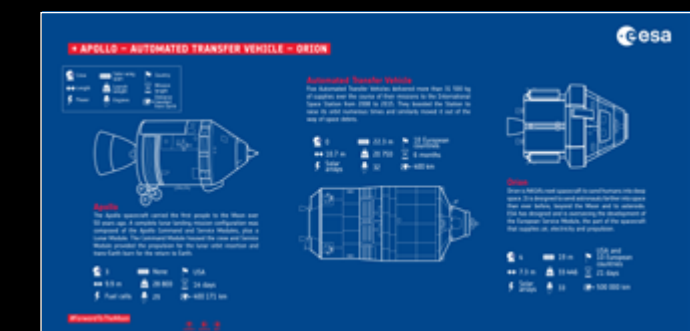
Orion temperature control



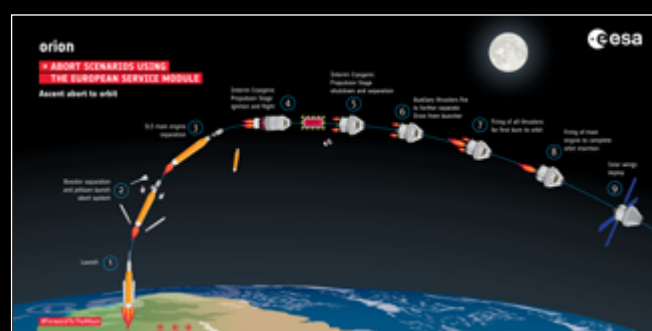
Orion avionics



an international collaboration



Apollo – Automated Transfer Vehicle – Orion



Orion abort scenarios
Ascent abort to orbit

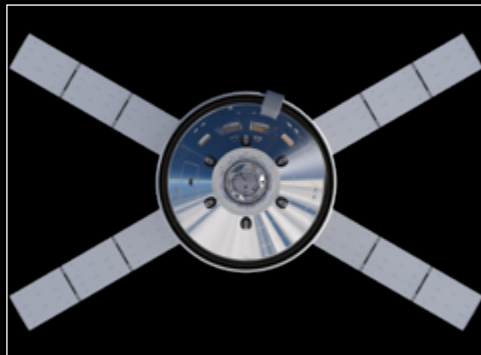


Orion abort scenarios
Untargeted abort splashdown

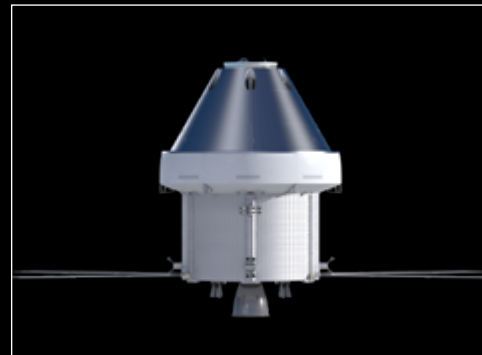


Orion abort scenarios
Targeted abort splashdown

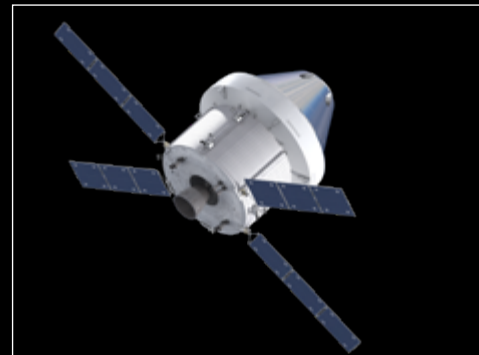
Artist impressions



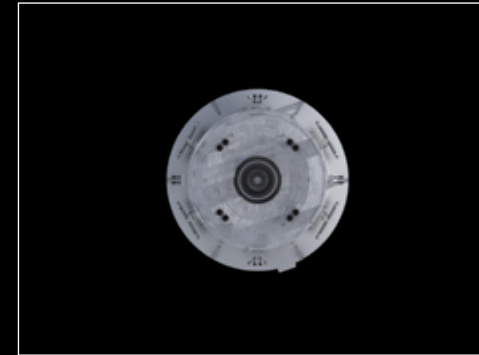
Orion front view



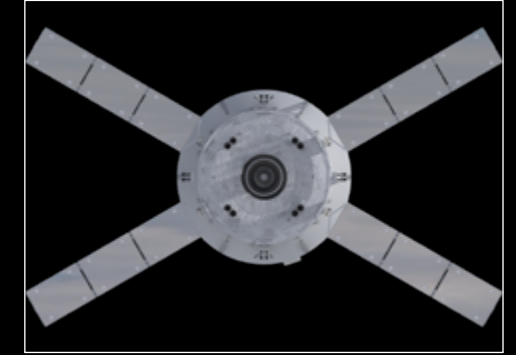
Orion side view with solar arrays unfolded



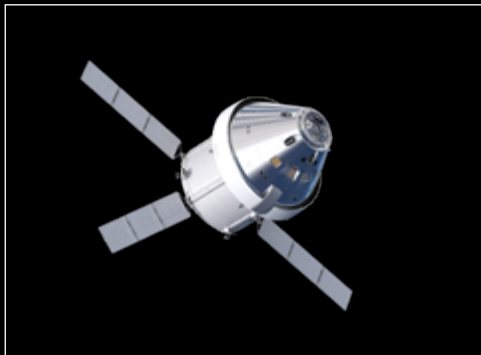
Orion



Orion back view



Orion back view with solar arrays unfolded



Orion



Orion spacecraft launch configuration



Orion leaving Earth



Orion initial design



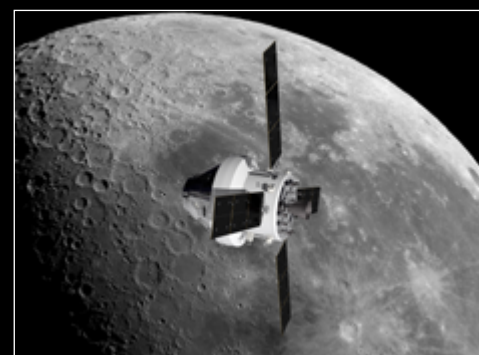
Orion spacecraft



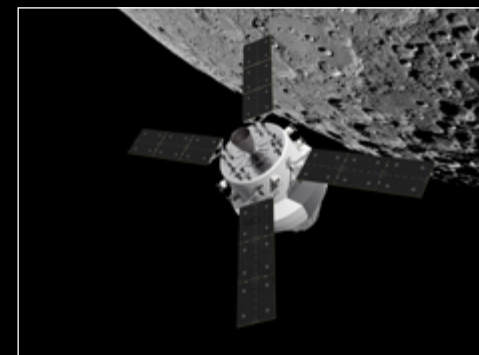
Orion



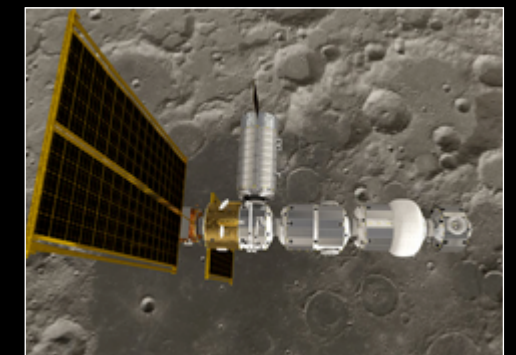
Orion spacecraft in Earth orbit



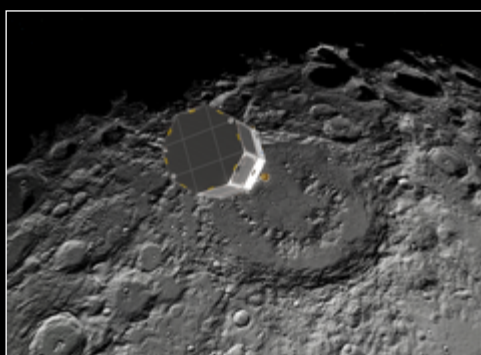
Orion in the vicinity of the Moon



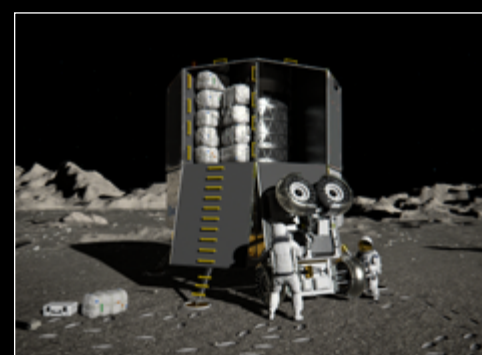
Orion in the vicinity of the Moon



Gateway over Moon



European Large Logistic Lander approaching Moon



European Large Logistic Lander unloading cargo



European Large Logistics lander landing

Videos and animations



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

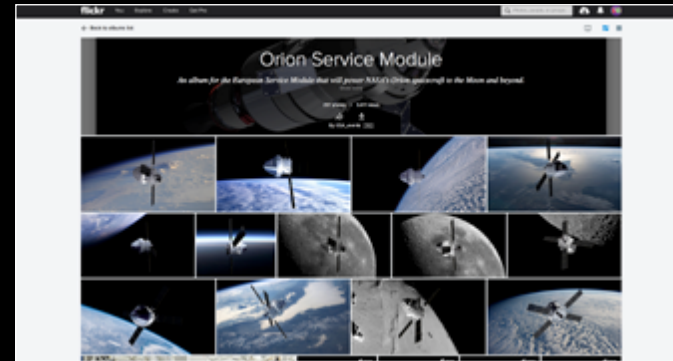


How we are going
to the Moon

Websites



Orion blog



Orion European Service Module Flickr

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

Philippe Berthe

Philippe.Berthe@esa.int

European Space Agency

ESTEC, Noordwijk, The Netherlands



ESA Orion blog

www.esa.int/orion



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Official hashtags:

#ForwardToTheMoon

#ExploreFarther

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