

# LIVING IN THE SOLAR SYSTEM

## *What's the best way to choose your destination?*

In the future, to enable astronauts to **spend long periods of time on another celestial body** in the solar system, new infrastructure will need to be developed to meet the constraints of the chosen planet or satellite. Protection against radiation and meteorites, power generation, water extraction and recycling, food production... are all challenges that astronauts will have to face. The European Space Agency's **Moon Camp** European challenge, coordinated in France by **CNES** with the **ESERO** France programme, invites schoolchildren to become explorers of our solar system and find solutions to the problems that astronauts might encounter, by suggesting the **space base best suited to their environment**.

As our closest neighbour, the Moon will logically be the first stage in humanity's future settlement beyond Earth. But it is not the only celestial body that might one day see humans on its surface. **Mars, Venus, Jupiter's moons and even exoplanets** could also be targeted by astronauts in the future.

With such a choice of potentially habitable worlds, it is important to fully understand each one's characteristics in order to **adapt the space base to the constraints** of the chosen target. For example, it seems highly unlikely that it will ever be possible to settle on one of the four "gas giants" (Jupiter, Saturn, Uranus and Neptune) since, strictly speaking, they have no solid surface on which to land.

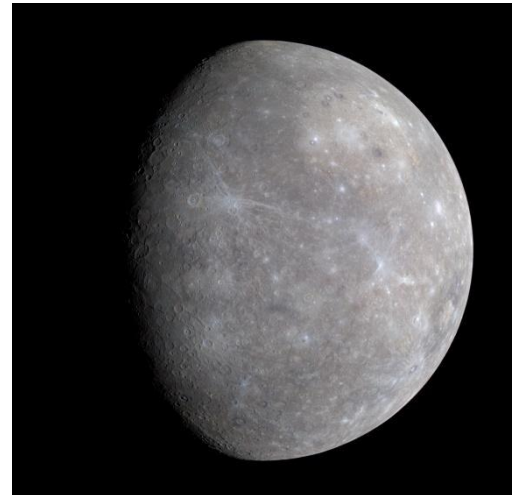




## Rocky planets

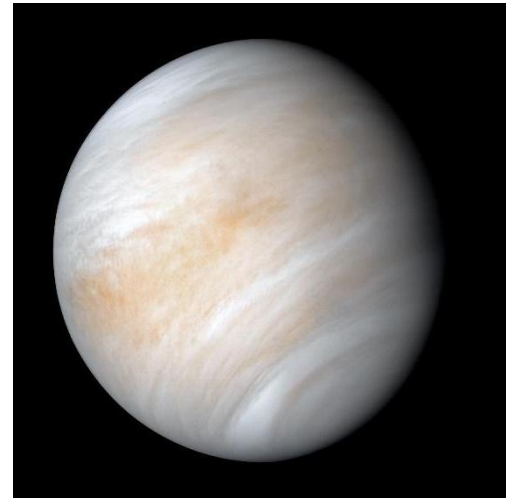
### Mercury:

- Closest planet to the Sun
- Radius: 2440 km (0.383 times the Earth's radius)
- Atmosphere: almost none
- Gravity: 0.38 times that of the Earth
- Length of a solar (sidereal) day: 176 d (88 d)
- Length of a year: 88 days
- Length of the journey: ~7 years
- Surface temperature: min =  $-183^{\circ}\text{C}$   
max =  $+427^{\circ}\text{C}$



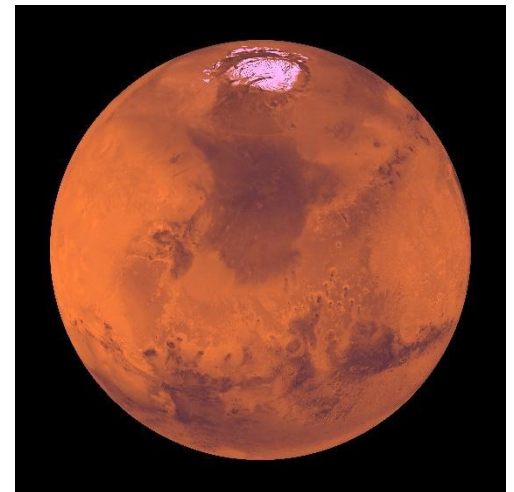
## Venus:

- Hottest planet in the Solar System
- Radius: 6052 km (0.95 times the Earth's radius)
- Atmosphere: 92 times that of the Earth
- Gravity: 0.91 times that of the Earth
- Length of a solar (sidereal) day: 117 d (243 d)
- Length of a year: 225 days
- Length of the journey: ~5 months
- Surface temperature: min = +446°C  
max = +490°C



## Mars:

- Presence of frozen water on the surface
- Radius: 3396 km (0.53 times the Earth's radius)
- Atmosphere: 0.006 times that of the Earth
- Gravity: 0.38 times that of the Earth
- Length of a day: 24.6 h
- Length of a year: 687 days
- Length of the journey: ~6 months
- Surface temperature: min = -143°C  
max = +20°C



# Satellites

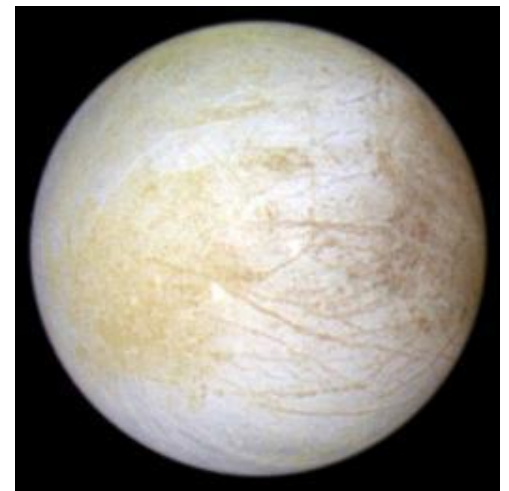
## Moon (Earth):

- Nearest body to Earth
- Radius: 1737 km (0.27 times the Earth's radius)
- Atmosphere: almost none
- Gravity: 0.17 times that of the Earth
- Length of a day: 28 days
- Length of the journey: 3-4 days
- Surface temperature: min =  $-233^{\circ}\text{C}$   
max =  $+123^{\circ}\text{C}$



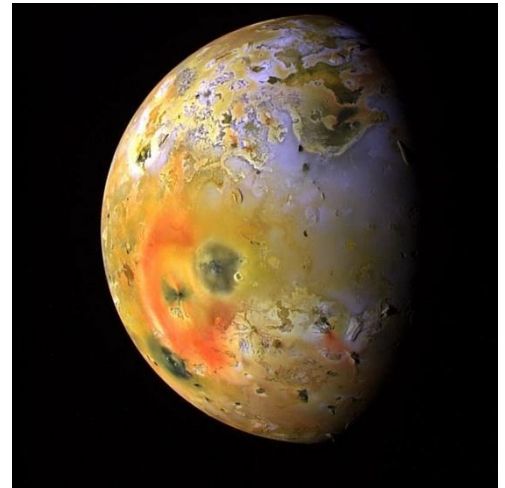
## Europa (Jupiter):

- The body with the most water
- Radius: 3122 km (0.49 times the Earth's radius)
- Atmosphere: almost none
- Gravity: 0.13 times that of the Earth
- Length of a day: 3.6 days
- Length of the journey: ~5 years
- Surface temperature: min =  $-223^{\circ}\text{C}$   
max =  $-148^{\circ}\text{C}$



## Io (Jupiter):

- Body with the most active volcanoes
- Radius: 1822 km (0.29 times the Earth's radius)
- Atmosphere: almost none ( $\sim 10^{-9}$  times that on Earth)
- Gravity: 0.18 times that of the Earth
- Length of a day: 1.8 days
- Length of the journey:  $\sim 5$  years
- Surface temperature: min =  $-183^{\circ}\text{C}$   
max =  $-143^{\circ}\text{C}$



## Ganymede (Jupiter):

- Largest satellite in the Solar System
- Radius: 2634 km (0.41 times the Earth's radius)
- Atmosphere: almost none
- Gravity: 0.15 times that of the Earth
- Length of a day: 7.2 days
- Length of the journey:  $\sim 5$  years
- Surface temperature: min =  $-203^{\circ}\text{C}$   
max =  $-121^{\circ}\text{C}$





## Callisto (Jupiter):

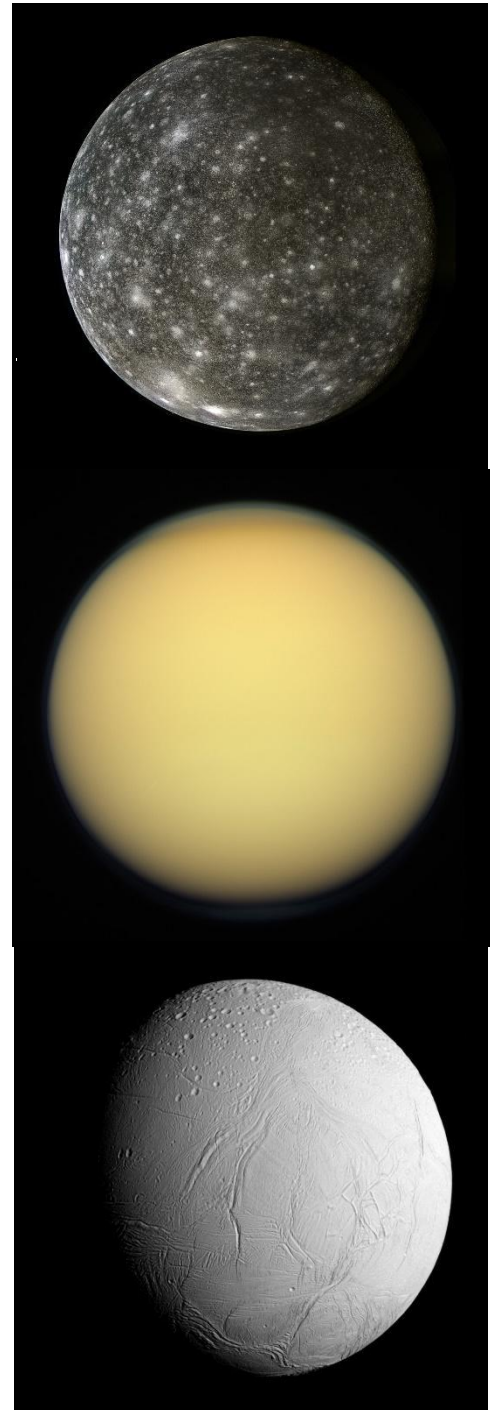
- Radius: 2410 km (0.38 times the Earth's radius)
- Atmosphere: almost none
- Gravity: 0.13 times that of the Earth
- Length of a day: 16.7 days
- Length of the journey: ~5 years
- Surface temperature: min =  $-193^{\circ}\text{C}$   
max =  $-118^{\circ}\text{C}$

## Titan (Jupiter):

- Satellite with the densest atmosphere
- Radius: 2575 km (0.40 times the Earth's radius)
- Atmosphere: 1.45 times that of the Earth
- Gravity: 0.14 times that of the Earth
- Length of a day: 16 days
- Length of the journey: ~7 years
- Surface temperature:  $-180^{\circ}\text{C}$

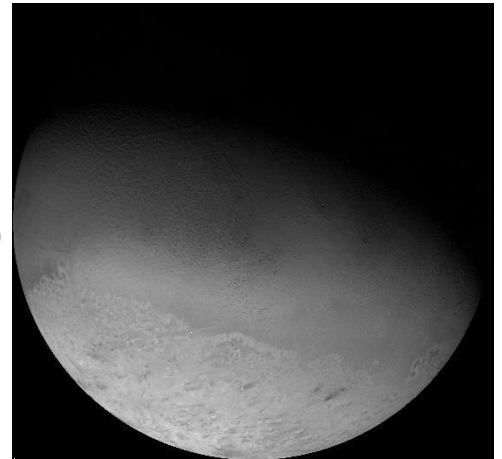
## Enceladus (Saturn):

- Smallest satellite with liquid water
- Radius: 252 km (0.04 times the Earth's radius)
- Atmosphere: almost none
- Gravity: 0.01 times that of the Earth
- Length of a day: 1.4 days
- Length of the journey: ~7 years
- Surface temperature: min =  $-240^{\circ}\text{C}$   
max =  $-128^{\circ}\text{C}$



## Triton (Neptune):

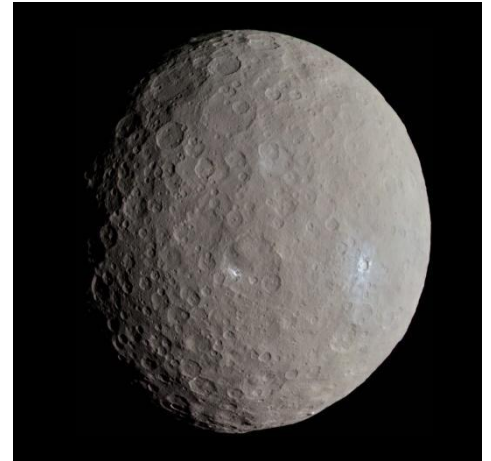
- Potential dwarf planet captured by Neptune
- Radius: 1353 km (0.21 times the Earth's radius)
- Atmosphere: thin ( $1.4 \times 10^{-5}$  times that of the Earth)
- Gravity: 0.08 times that of the Earth
- Length of a day: 5.9 days
- Length of the journey: >15 years
- Surface temperature:  $-235^{\circ}\text{C}$



## Dwarf planets

### Ceres:

- The only dwarf planet in the asteroid belt
- Radius: 939 km (0.15 times the Earth's radius)
- Atmosphere: none
- Gravity: 0.03 times that of the Earth
- Length of a day: 9 h
- Length of the journey: ~4 years
- Surface temperature: min =  $-163^{\circ}\text{C}$   
max =  $-38^{\circ}\text{C}$



### Pluto:

- Largest dwarf planet
- Radius: 1188 km (0.19 times the Earth's radius)
- Atmosphere: thin ( $10^{-5}$  times that of the Earth)
- Gravity: 0.06 times that of the Earth
- Length of a day: 6.4 days
- Length of the journey: >15 years
- Surface temperature: min =  $-240^{\circ}\text{C}$   
max =  $-218^{\circ}\text{C}$

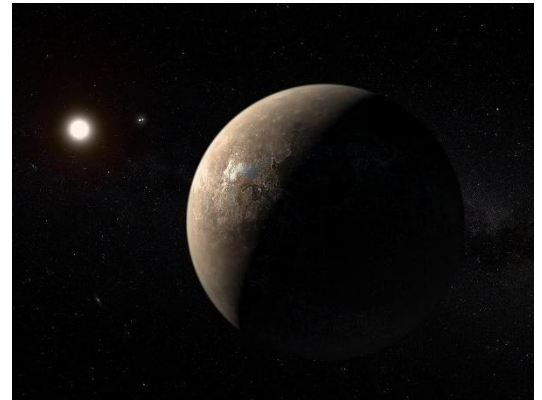




# Exoplanets

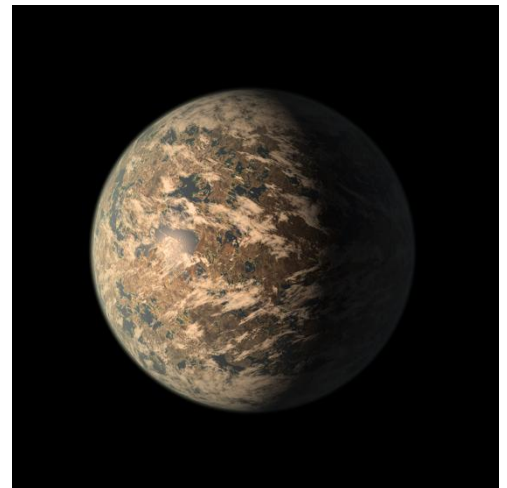
## Proxima Centauri b:

- Nearest Earth-like exoplanet
- Mass: ~1.05 times that of the Earth
- Atmosphere: unknown
- Gravity: probably similar to the Earth
- Length of a day: synchronous rotation (one side constantly illuminated and the other constantly in the dark)
- Star: Red dwarf (very active); T ~2700°C
- Length of the journey: 75,000 to 100,000 years
- Surface temperature: estimated at between -50 and +50°C



## TRAPPIST-1 f:

- System of seven planets the size of the Earth
- Mass: ~0.7 times that of the Earth
- Atmosphere: unknown
- Gravity: estimated at 0.8 times that of the Earth
- Length of a day: synchronous rotation (one side constantly illuminated and the other constantly in the dark)
- Star: Red dwarf (very active); T ~2300°C
- Length of the journey: 750,000 to 1,000,000 years
- Surface temperature: estimated at -50°C



## Luyten b:

- Exoplanet classified as a "super-Earth"
- Mass: 2.9 times that of the Earth
- Atmosphere: unknown
- Gravity: more than twice that of the Earth
- Length of a day: synchronous rotation  
(one side constantly illuminated and the other constantly in the dark)
- Star: Red dwarf (very active);  $T \sim 2300^{\circ}\text{C}$
- Length of the journey: 200,000 to 300,000 years
- Surface temperature: estimated at between  $-20$  and  $20^{\circ}\text{C}$

