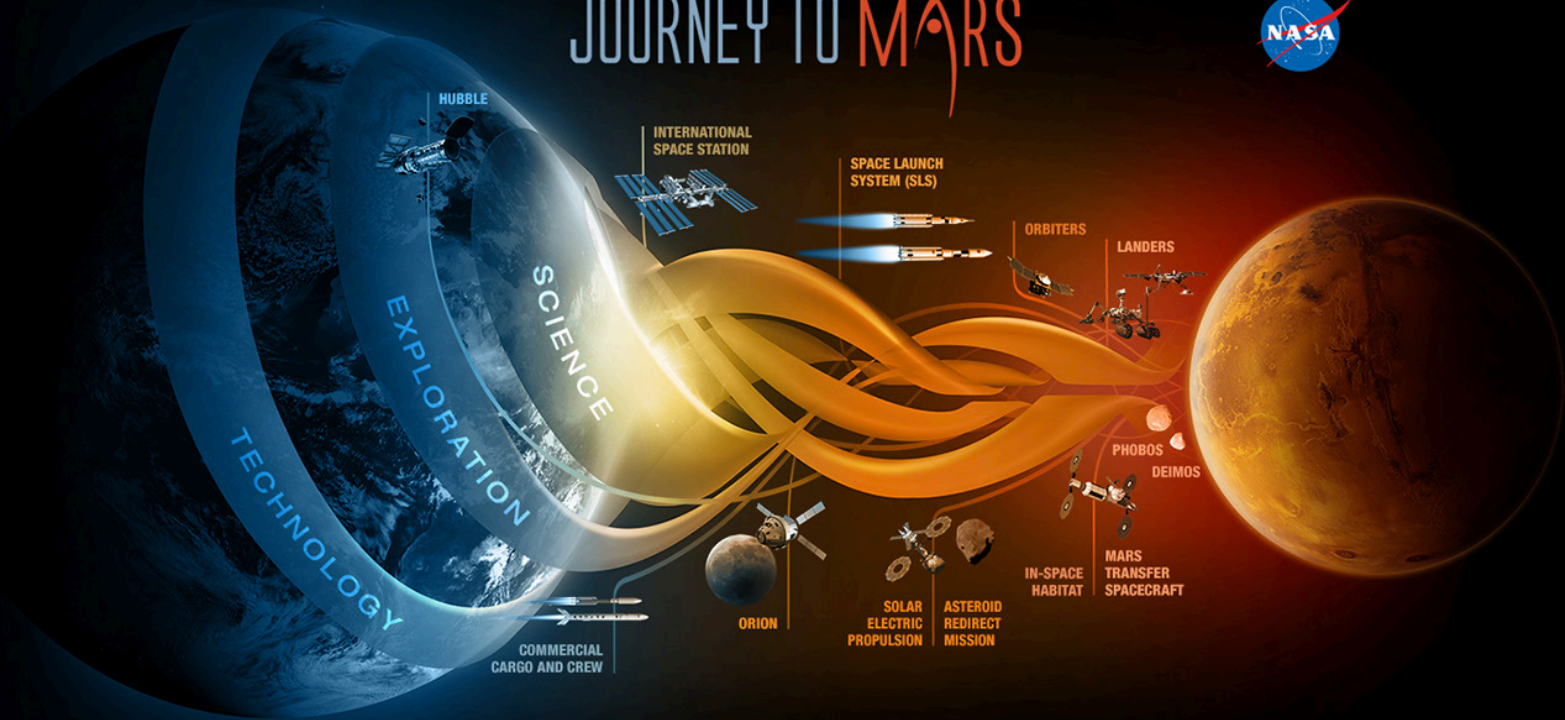


# JOURNEY TO MARS



PROJECT TEAM

## PROPULSION

NASA is developing the capabilities needed to send humans to an asteroid by 2025 and Mars in the 2030s – goals outlined in the bipartisan NASA Authorization Act of 2010 and in the U.S. National Space Policy, also issued in 2010.

Mars is a rich destination for scientific discovery and robotic and human exploration as we expand our presence into the solar system. Its formation and evolution are comparable to Earth, helping us learn more about our own planet's history and future. Mars had conditions suitable for life in its past. Future exploration could uncover evidence of life, answering one of the fundamental mysteries of the cosmos: Does life exist beyond Earth?

While robotic explorers have studied Mars for more than 40 years, NASA's path for the human exploration of Mars begins in low-Earth orbit aboard the International Space Station. Astronauts on the orbiting laboratory are helping us prove many of the technologies and communications systems needed for human missions to deep space, including Mars. The space station also advances our understanding of how the body changes in space and how to protect astronaut health.

Our next step is deep space, where NASA will send a robotic mission to capture and redirect an asteroid to orbit the moon. Astronauts aboard the Orion spacecraft will explore the asteroid in the 2020s, returning to Earth with samples. This experience in human spaceflight beyond low-Earth orbit will help NASA test new systems and capabilities, such as Solar Electric Propulsion, which we'll need to send cargo as part of human missions to Mars. Beginning in 2018, NASA's powerful Space Launch System (SLS) rocket will enable these "proving ground" missions to test new capabilities. Human missions to Mars will rely on Orion and an evolved version of SLS that will be the most powerful launch vehicle ever flown.

A fleet of robotic spacecraft and rovers already are on and around Mars, dramatically increasing our knowledge about the Red Planet and paving the way for future human explorers. The Mars Science Laboratory Curiosity rover measured radiation on the way to Mars and is sending back radiation data from the surface. This data will help us plan how to protect the astronauts who will explore Mars. Future missions like the Mars 2020 rover, seeking signs of past life, also will demonstrate new technologies that could help astronauts survive on Mars.

## Your Mission

Your science team has been charged with creating a proposal for how the ship carrying the first astronauts to reach Mars will be propelled.

Traveling to Mars will take a much longer time than any previous journey astronauts have made. The distance is immense, and traveling to the planet will involve trade offs between speed, cargo capacity, and the limits of available technology.

# Research Questions

Before you can research how astronauts can make the journey to Mars, you will first need to think a bit about what kinds of questions you will need to answer (and what kind of questions each of those questions requires). Examples might include:

## “How will the spaceship be propelled?”

(What kinds of propulsion systems might exist to get us to Mars faster than normal?)

## “What will our propulsion system require?”

(Do we need to carry fuel? If so, how much fuel?)

## “How long will a trip to Mars take?”

(How fast can we travel? How long is the journey? How much weight can we transport in that time, over that distance?)

## “What kinds of dangers might be present on such a voyage, and how can we deal with them?”

(Are there risks to our propulsion system? Can we deal with them?)

# What Will Your Research Questions Be?

