Mars 2020: **Perseverance Rover**

What is a rover?

A rover is a robotic vehicle that is designed to explore the surface of a planet or moon.

In the last 50 years, six rovers have reached the surface of Mars.

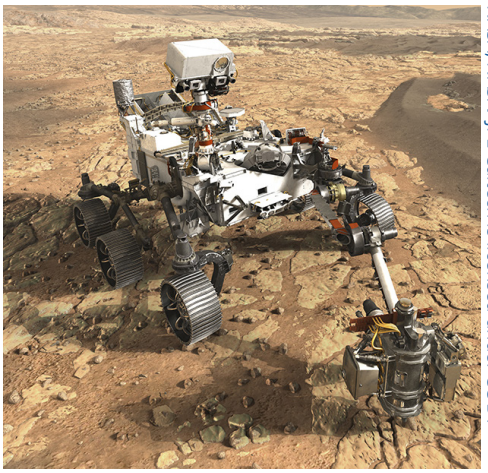
1971 Two Soviet Mars rovers were lost soon after landing.

1997 NASA's Sojourner was the first rover to successfully land on Mars.

2004 NASA's Mars Exploration Rovers (MER) Spirit and Opportunity both landed successfully. Spirit concluded its mission in 2010. Opportunity operated for 14 years and travelled 45.16km across the surface of Mars.

2011 NASA's Curiosity rover landed on Mars. Its mission is still in progress and it continues to send scientific data back to Earth.

Perseverance is the latest Mars rover. It was launched from Earth on 30th July 2020 and has a landing date of 18th February 2021.



NASA's Mars 2020 Rover Artist's Concept #1 by NASA, NASA/ JPL-Caltech is licensed under CC BY

An artist's impression of Perseverance on the surface of Mars.

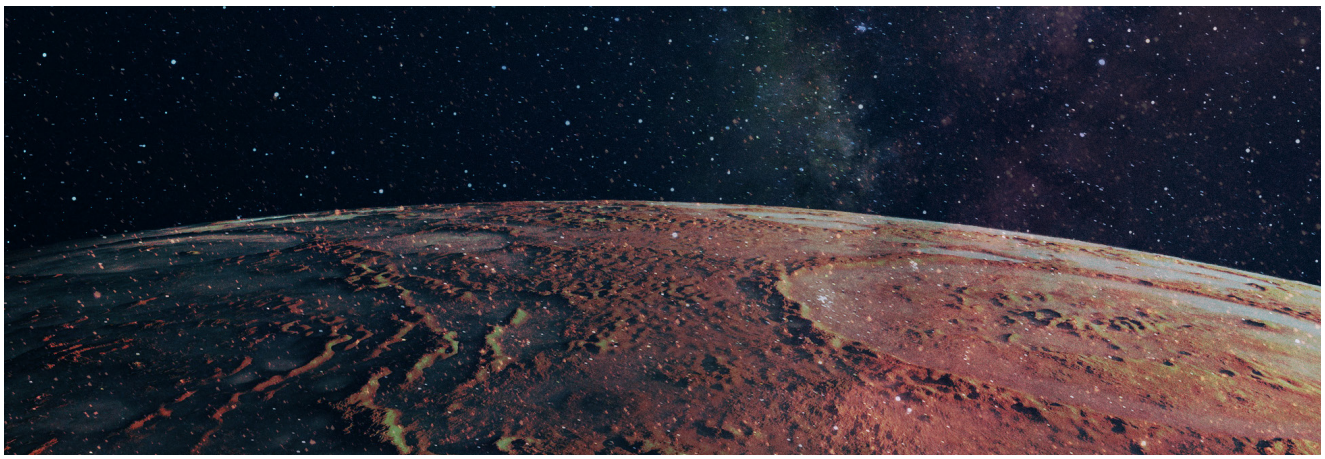
Why do scientists want to explore Mars?

Mars is a good target for space exploration because it is the closest planet to Earth and is the most similar planet to Earth in our Solar System.

On Earth, life can be found almost everywhere that there is water. This is why one of the goals in exploring Mars is to look for evidence of water. Scientists want to know if life ever existed on Mars.

Planetary geologists can study the rocks and soil on Mars to uncover the history of its surface. Sampling the atmosphere can help us to explain why it is thinner than the atmosphere on Earth. This can help us to learn more about the history of Earth and other planets in the Solar System too.

Robotic missions to Mars can discover the hazards that astronauts would face when manned missions eventually reach the planet. These missions also explore the resources available on Mars. Since an expedition to the planet would last around two years, astronauts would need to pack everything they need for that period. Manned missions would be easier if there were resources on Mars that they could use.



What have previous missions found out?

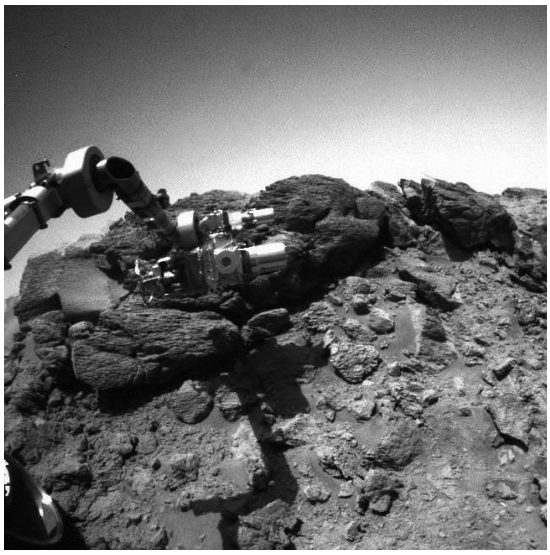
Sojourner took lots of photos of the Martian landscape and studied what rocks and dirt were made of. From Earth, Mars looks cold, dry and rocky but the data sent back by Sojourner suggested it used to be a warmer, wetter place.

Spirit and **Opportunity** found minerals in rocks that usually form in water. They also found evidence that past conditions on Mars could have supported life, if it existed.

Curiosity is still sending back data from Mars. So far it has discovered:

- evidence of persistent water, like rivers and lakes;
- clay minerals that suggest fresh water was once present;
- samples that show ancient Mars had the correct chemistry to support microbes similar to those found on Earth;
- organic molecules – the raw ingredients of life;
- methane – a gas given off by living organisms or reactions between rocks and water;
- levels of radiation that would be a health risk to humans.

The rovers have determined that Mars once had habitable conditions.



Attacking Mars by NASA, Cornell Univ., JPL and M. Di Lorenzo et al. is licensed under CC BY

Spirit's camera captures its Instrument Deployment Device inspecting some interesting rocks.

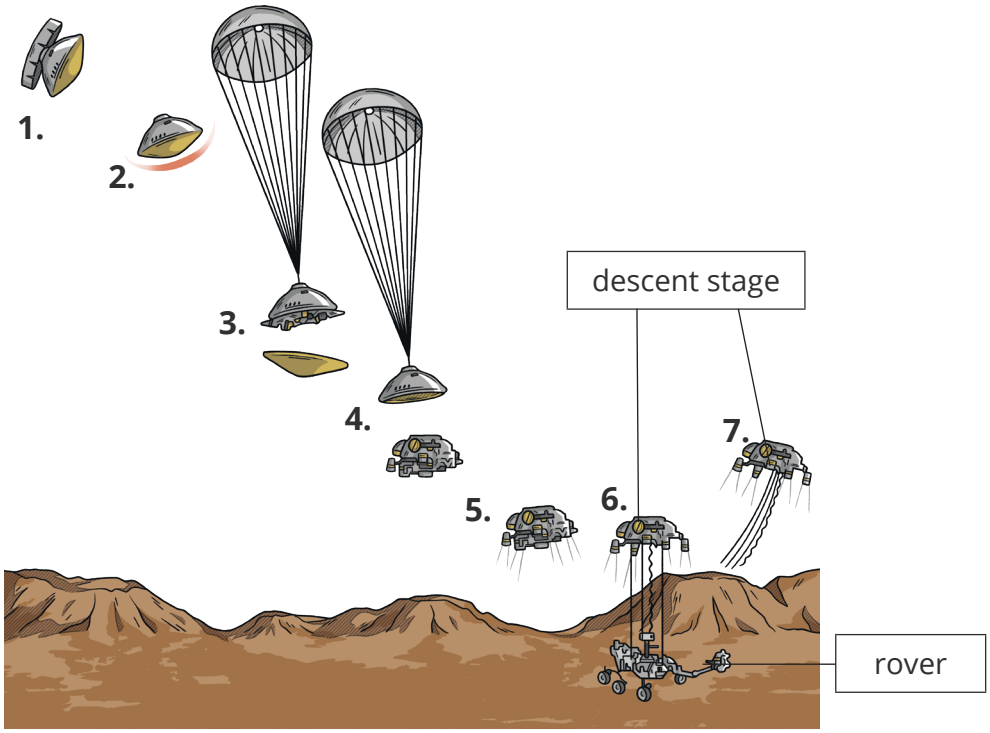
Curiosity Self-Portrait at 'Big Sky' Drilling Site by NASA, is licensed under CC BY

Curiosity takes a 'selfie' with the camera on the end of its robotic arm.

What are the goals for the Perseverance mission?

1. **Determine whether life ever existed on Mars.**
   The rover has a radar system that can look for water or ice up to 10 metres below the surface. The rover will seek out rocks that formed in water and that preserve evidence of organic molecules.
2. **Characterise the climate of Mars.**
   The rover carries a weather station that will measure the temperature, wind speed, pressure, humidity and dust levels on Mars.
3. **Characterise the geology of Mars.**
   It has instruments that will use x-rays and an ultraviolet laser to examine the rocks. It also has a drill that will collect rock samples, which will be collected and brought back to Earth by a future mission.
4. **Prepare for human exploration.**
   The rover will test technology required to produce oxygen from the carbon dioxide rich atmosphere.

What can we expect from the landing?



Entry

1. 10 minutes before it enters the Martian atmosphere, the spacecraft sheds its cruise stage which contains the equipment used to travel to the planet.
2. As the spacecraft enters the Martian atmosphere, it is slowed down by air resistance. The atmosphere causes the heat shield to reach 1300°C, making it glow. The spacecraft slows down to 1000mph.
3. The parachute deploys at an altitude of 11km and a velocity of 940mph. 20 seconds later the heat shield separates and falls away. The rover is now exposed to the atmosphere of Mars; cameras and instruments on the rover start to identify features on the surface. It compares these features to onboard maps to help it pick the safest spot it can reach to land.

Descent

4. Since the atmosphere on Mars is thin, the parachute can only slow the rover to about 200mph – but this is still too fast to land. The parachute is cut free at around 2100m from the surface and rockets are fired up to further slow the descent.
5. About 12 seconds before landing, the rover is travelling at 1.7mph. The descent stage lowers the rover down on a set of 6.4m cables (this is known as the sky crane manoeuvre). The rover locks its legs and wheels into landing position.

Landing

6. As soon as the rover senses that its wheels have touched the ground, it cuts the cables that connect it to the descent stage.
7. The descent stage flies off and then crash-lands.