

Teacher Pack

KS3 Mars Activities – 'Conditions on Mars' and 'Humans or Robots'

Topics covered: Conditions on Mars, features found on the planet, calculating ranges and averages, reading and interpreting data.



Introduction:

Mars is the fourth planet from the Sun and has fascinated humankind for centuries. Although no people have been to the planet, we have sent lots of spacecraft and rovers to explore this distant world. We will be starting off with a few teacher notes to give you an outline of the activities included and information you may find useful. You will then find some fact files to be used by your students, and a printable activity sheet and an answer sheet.

Teacher's Notes:

We recommend that you start off by showing your students our 'Mission to Mars' video. It is available on our website (<https://www.rmg.co.uk/schoolscommunities/learning-resources/mission-mars>) and on our Vimeo page (<https://vimeo.com/398015506>).

In this pack we provide two activities – 'Conditions on Mars' and 'Humans or Robots?'

In the first activity '**Conditions on Mars**' students use real data from active missions on Mars (the Curiosity and Perseverance rovers) and their mathematical skills to explore the conditions on Mars. Each student should be provided with a fact file about Mars, and the information on the Perseverance and Curiosity Rovers. We also have an answer sheet available to print.

In the second activity we ask students to decide whether humans or robots should go to Mars in the future – '**Humans or Robots?**'

You could use the prompts listed in Activity 2 below to start a conversation about which would be better to explore Mars – humans or robots?

Either as a class or in teams, make some lists of what humans need and what robots need. You could also then make a list of advantages and disadvantages of both types of exploration. We've provided some lists you can use, but these aren't exhaustive!

Once you've had time to consider, students can split into 'team human' and 'team robot' and present the advantages of their chosen type of exploration. Maybe there could be a class vote to see what the consensus will be!

Curriculum Links:

Working Scientifically - **Analysis and Observation, Measurement**

Language and Literacy – **Spoken Language (discussion and debate)**

Extension Activities:

If you're interested in exploring Mars data further with your class, there is a wealth of information online about the exploration of Mars. You could:

- Explore current weather reports on Mars taken by the Curiosity Rover (<https://mars.nasa.gov/msl/weather/>) or Perseverance Rover (<https://mars.nasa.gov/mars2020/weather/>).
- Listen to real sounds recorded by the Perseverance Rover (<https://mars.nasa.gov/mars2020/multimedia/audio/>).
- Study incredible photos of the planet taken by a satellite currently orbiting the planet, the Mars Reconnaissance Orbiter (https://www.nasa.gov/mission_pages/MRO/images/index.html).

The Perseverance Rover



The Perseverance Rover is exploring Jezero crater, in the Isidis region of Mars' northern hemisphere.

This crater is 45 km wide, and used to contain a lake more than 3.5 billion years ago.

The rover is 3 m long and weighs 1,025 kg (about the same as a car).

Perseverance Rover brought a helicopter with it to Mars (you can see it behind the rover in the image above). They're both currently exploring this dried-up lake bed for signs of ancient life!



Image Credit: NASA/JPL-Caltech/MSSS

Date	Sol*	Air Temperature (°C)		Air Pressure (Pa)	Sunrise	Sunset
		Max	Min			
Sep. 21, 2022	565	-20	-88	754.2	07:13	18:18
Sep. 22, 2022	566	-20	-87	747.7	07:13	18:19
Sep. 23, 2022	567	-19	-88	743.5	07:13	18:19
Sep. 24, 2022	568	-18	-86	738.4	07:13	18:20
Sep. 25, 2022	569	-18	-85	733.2	07:13	18:20

*A sol is a solar day, one day on Mars. This is a count of how many days the rover has been active on the planet. So the 21st September 2022 is the 565th day of Perseverance's mission!

The Curiosity Rover



The Curiosity Rover is exploring Gale crater in the southern hemisphere of Mars, near the equator.

The rover is 3 m long and weighs 899 kg. Curiosity landed in August 2012 and so has been operating for over 10 years.

Gale crater is 154 km in diameter. It was formed in a meteorite impact around 3.7 billion years ago. Ground water and rivers then filled the crater with water. In this image the landing site for Curiosity is ringed in black. Curiosity is exploring this now dried-up lakebed for signs of ancient life.



Image Credit: NASA/JPL-Caltech/MSSS

Date	Sol*	Air Temperature (°C)		Air Pressure (Pa)	Sunrise	Sunset
		Max	Min			
Sep. 21, 2022	3599	-8	-69	827	06:38	18:52
Sep. 22, 2022	3600	-4	-70	822	06:39	18:52
Sep. 23, 2022	3601	-5	-70	823	06:39	18:52
Sep. 24, 2022	3602	-6	-71	818	06:39	18:52
Sep. 25, 2022	3603	-7	-70	820	06:40	18:53

*A sol is a solar day, one day on Mars. This is a count of how many days the rover has been active on the planet. So the 21st September 2022 was the rover's 3,599th day on Mars!

Mars Facts

Mars is over 50 million km away from Earth and it can take spacecraft over 6 months to reach the planet.

Mars has huge dust storms that can damage equipment and block sunlight from reaching the ground.

Mars can get as cold as -140°C and as warm as 20°C .

Mars has no liquid water on the surface.

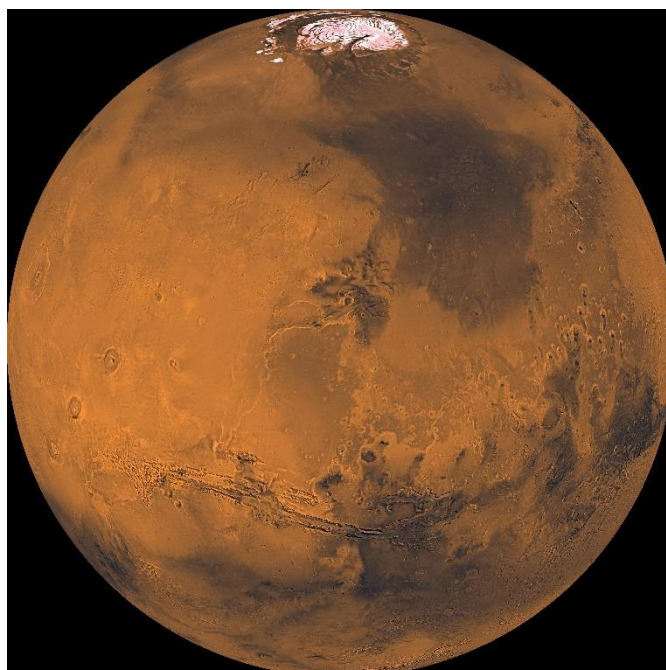
Mars is covered in rocks, gravel, boulders and dust.

Mars has very little atmosphere – there isn't any oxygen for humans to breathe.

Mars doesn't have a magnetic field, which means the planet isn't protected from harmful rays from the Sun.

Mars has a lower gravity compared to the Earth. You could jump two and a half times higher than your biggest jump possible here on Earth!

Mars has the deepest canyon in the solar system, and the biggest volcano!



Conditions on Mars Activity 1

1. Which site had the highest daily temperature?

2. What could be one possible reason for one site having a higher temperature?

3. Calculate the average daily minimum temperature from the Perseverance data:

4. Which site has the lowest air pressure reading?

5. The average air pressure here on Earth's surface is 101,320 Pa. Compare this to Mars' lowest air pressure reading. How many times lower is Mars' pressure?

6. What impact would the low air pressure have on astronauts on the surface?

7. What is the largest temperature difference within one day measured by Curiosity?

8. What could be causing the large difference in temperature over the course of one Martian day?

9. Can you calculate the number of hours of daylight at Jezero Crater and Gale Crater on the 21st September?

10. Can you work out which coordinates belong to which location on Mars? Why would one location have less hours of daylight?

Longitude: 137°, Latitude -4° is the location of _____

Longitude: 77°, Latitude 18° is the location of _____

Activity 2 – Humans or Robots?

1. In your group, have a think about the information you've been given in your activities so far, the 'Mission to Mars' video, and the fact files.
2. Do you think that humans should go to Mars, or should further uncrewed missions (like rovers, landers, satellites, and drones) be sent to Mars?
3. Spend some time thinking of the advantages and disadvantages of each, and decide if you're 'Team Human' or 'Team Robot'.

Questions to think about:

- What is the environment like on Mars?
- What do humans need to survive on Mars?
- What do robots (or satellites, landers, rovers, drones etc) need to survive on Mars?
- How will the mission reach Mars? How long will it spend there? Will it need to return?
- What happens if something goes wrong?
- How much work can a robot do independently?
- What equipment will humans need to run science experiments on Mars?
- How much will the mission cost?
- What happens if we do find signs of life on Mars?

Activity 1 - Conditions on Mars – Answers

1. Which site had the highest daily temperature?

Gale Crater (where Curiosity is exploring).

2. What could be one possible reason for one site having a higher temperature reading?

They are at different locations on Mars. Mars also has seasons - where Gale Crater is in the southern hemisphere it's summer in September 2022. Where Jezero crater is in the northern hemisphere it's winter in September 2022.

3. Calculate the average daily minimum temperature from the Perseverance data.

-86.8 °C

4. Which site has the lowest air pressure reading?

Jezero Crater (733.2 Pascals)

5. The average air pressure here on the surface of the Earth is 101,320 Pa. Compare this to Mars' lowest air pressure reading – how many times lower is the reading on Mars?

138 times lower.

6. What impact would the low air pressure have on astronauts exploring the surface?

They wouldn't be able to breathe! It would also affect how sound travels through the air. They would need to wear spacesuits.

7. What is the largest temperature difference within one single day measured by Curiosity?

66 °C (Sol 3,600)

8. What could be causing the large difference in temperature over the course of one Martian day?

The maximum temperature was recorded during the day, and the minimum at night. As the atmosphere is very thin, when night falls more of the heat from the surface is lost to space.

9. Can you calculate the number of hours of daylight at Jezero Crater and Gale Crater on September 21st? Why would one location have less hours of daylight?

Jezero Crater - 11 hours, 5 minutes.

Gale Crater - 12 hours, 14 minutes.

They are at different locations on Mars, and experiencing different seasons. Mars has seasons as it has a tilt to its axis just like the Earth. Gale Crater is in the southern hemisphere, where it's summer in September 2022. Where Jezero crater is in the northern hemisphere it's winter in September 2022. When it is winter the northern hemisphere is tilted away from the Sun, and receives shorter hours of daylight.

10. Can you work out which coordinates belong to which location on Mars?

Longitude: 137°, Latitude -4° is the location of Curiosity

Longitude: 77°, Latitude 18° is the location of Perseverance

This was tricky! Students have to understand that latitude corresponds to distance from the equator of the planet. A latitude of -4 degrees is south of the Equator, whereas a latitude of 18 degrees is north of the Equator (and further from the Equator). The general location of each rover is provided in the fact file.

Activity 2 – Humans or Robots? – Answers

There is no right or wrong answer to this question!

However if your students want to share their decision with us please let us know – you can email ROGEducation@rmg.co.uk or tweet us @ROGAstronomers.