Mars is the fourth planet from the Sun, the ‘Red Planet’, and can be seen from Earth with a telescope at various times in the year. The red colour comes from iron in the soil, in a similar way to soils found on Earth. It is smaller than Earth and further away from the Sun (about 1.5 times further away). A day on Mars is very similar in length to a day on Earth and the planet takes 687 days to orbit the Sun. Mars has two moons, Phobos and Deimos. There have been a number of spacecraft launched with the intention of orbiting Mars (the earliest successful one was in 1965 as part of the Mariner programme) and some have been designed to land on the planet. The successful missions have provided a lot of information about Mars.

**Discussion:** Why do you think more information is obtained about the planet by landing on it and analysing it *in situ*?

Mars rovers, Spirit and Opportunity, landed in January 2004 and explored the surface of Mars long after their expected 90 day expeditions, and their signals were still being received up until 2018 (see [https://mars.nasa.gov/mer/](https://mars.nasa.gov/mer/) for the latest news). These probes have provided much important information. Curiosity Rover landed in 2012 and began to explore the surface of Mars and it is still working (see [https://mars.nasa.gov/msl/home/](https://mars.nasa.gov/msl/home/) for the latest news). In recent papers published in 2020, scientists describe the ‘Initial results from the InSight mission to Mars’. NASA’s InSight (Interior exploration using Seismic Investigations, Geodesy and Heat Transport) craft landed on the *Elysium Planitia* (a broad plane that straddles the equator of Mars) on Mars on the 26th November 2018 (Figure 1). Its aim was to provide data to allow researchers to determine the structure of the interior of Mars, its seismicity and its impact cratering rate.

**Discussion:** Why couldn’t orbiters provide the same data? What do we know about the seismicity on Earth? What is *impact cratering rate* and why would we want to know this?

So, what has InSight found out in the first year of its mission? (live updates can be found from [https://mars.nasa.gov/insight/](https://mars.nasa.gov/insight/)).

174 marsquakes (note the name) had been detected in the first six months, with 150 small magnitude events that are from the crustal surface, and 24 sub-crustal events...
(from deeper into the surface of Mars) that are higher in magnitude (equivalent to 3-4 on the Richter scale used to measure earthquakes). Figure 2 demonstrates how marsquakes may move through the planet. Two of the largest marsquakes were located near the Cerberus Fossae fracture system. On Earth, earthquakes occur along the boundaries between different tectonic plates. Mars does not have tectonic plates like Earth but does have volcanoes and marsquakes seem to occur at the boundary between different rock systems along the fault lines generated, it is assumed, by the volcanic activity in the past (Figure 3). Seismic activity is very low during the martian night but increases in the day and scientists are analysing data to understand why this occurs.

Do you know that moonquakes have also been detected on the Earth’s moon?

The magnetic field detected by InSight is around ten times stronger than that inferred from orbiter measurements (a reason why surface measurements are so important) and preliminary studies suggest that there are magnetised rocks beneath the surface of Mars that are 3.9 billion years old. Mars did have a magnetic field like Earth a long time ago but does not now, but rocks have become magnetised and persist today.

InSight also provides weather data for Mars and it is now possible to obtain a daily weather report from the NASA website. A sol is a Mars day. It is slightly longer than an Earth day at 24 hours, 39 minutes and 35 seconds. As an example of data obtained, we have selected Sol 19. On this day, the wind speed varied between 7.5 and 17.5 metres per second (27-63 km/h), The temperature was about 180 K (-93.15 °C) just before Martian dawn and peaking at about 250 K (-23.15 °C) around Martian midday. The surface pressure varied between 720 and 760 Pascals (Pa) — this is over 100 times lower than Earth (on Earth, the surface pressure would be around 101,000 Pa). These are typical variations seen each day, while dust storms have been regularly detected.

In other words, it is windy, dusty and very cold on the surface of Mars. The Martian atmosphere contains mainly carbon dioxide (CO₂) and so you could not breathe on Mars without a space suit and a life support system.

The Teacher Guide that accompanies this series of I bet you didn’t know... articles on planets includes activities that enable children to learn more about the Earth and space, the processes of science research and to develop their own enquiry skills.

Activities that are relevant to this article include:

- Researching all the missions to Mars: which succeeded, and which failed, which countries led them and their objectives
- Finding out about some of the scientists/engineers who worked on the InSight program
- Investigating the formation of ‘craters’ by dropping meteors into sand
- Magnetising metals
- Analysis of Mars weather data – plotting graphs

**GLOSSARY**

**in situ**
in the original place

**Pascal**
a unit of pressure (equivalent to one Newton per square metre)

**seismic activity**
the types, frequency and size of earthquakes over a period of time in a given region

**sol**
a solar day on Mars (24 hours, 39 minutes, 35 seconds)

**tectonic plates**
massive pieces of land that connect together on the earth’s outer shell. These pieces bump together and move, just a few centimetres each year
The papers that inspired this work are:

The seismicity of Mars.


1. Swiss Federal Institute of Technology, Institute of Geophysics, Department of Earth Science, Zurich, Switzerland.
2. Université de Paris, CNRS, Institut de Physique du Globe de Paris, France.
3. Institut de Université de Paris, France, France.
4. Jet Propulsion Lab., California Institute of Technology, Pasadena, California, USA.
7. Swiss Federal Institute of Technology, Swiss Seismology Service SED, Zurich, Switzerland.
9. University of Zurich, Institute of Theoretical Physics, Zurich, Switzerland.
11. University of Nantes, CNRS, Laboratory of Planetology and Geodynamics, Nantes, France.
13. Sorbonne University, Laboratory of Meteorology and Dynamics, Paris, France.
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24. Royal Observatory, Belgium, Brussels, Belgium.
25. Institute of National Technology in Aerospace, Centre for Astrobiology, Madrid, Spain.
28. Marshall National Space Flight Centre, Huntsville, USA.
29. Université de Cote Azur, Observatory Cote Azur, Lagrange Laboratory, CNRS, Nice, France.

Crustal and time-varying magnetic fields at the InSight landing site on Mars.


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10. University of Paris Diderot, Institute of Physics, Sorbonne Paris, France.
11. UCBL, Ecole Normale Super Lyon, University of Lyon, CNRS, Laboratory of Geology, Lyon, France.
13. IUF, Paris, France.
14. Johns Hopkins University, Department of Earth and Planetary Science, Baltimore, MD 21218, USA.
The atmosphere of Mars as observed by InSight.
