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# WHAT HAVE WE FOUND AT MARS THIS YEAR?

2021 has been a busy year for the Red Planet. Three missions arrived in February, having set out seven months before to take advantage of the alignment of Earth and Mars's orbit, an event that only happens once every 26 months.

The first mission to arrive on 9 February was the United Arab Emirates' Hope orbiter, the nation's first planetary mission. The spacecraft's goal is to study the past and present climate of Mars from orbit. Unlike previous missions from other space agencies, which would only look at specific locations at the same time, Hope will look at changes throughout the day. Over time it will monitor Mars's daily, monthly and yearly changes to build up a comprehensive image of what the weather is like on the Red Planet.

The next arrival – Tianwen-1, belonging to the Chinese National Space Agency (CNSA) – reached Mars a day later, on 10 February. The spacecraft spent its first

few months at Mars surveying the surface from orbit, reconnoitring for the next stage of the mission: setting down the Zhurong rover. The CNSA eventually selected a site in the large Utopia Planitia and successfully touched down on 22 May. The main goal of the mission was a test of China's ability to operate on the surface of Mars, paving the way for future missions, however, both orbiter and rover are equipped with cameras, radar and spectrometers that will continue to survey the planet's surface and atmosphere.

But, back on 18 February – before the Tianwen-1 mission had located a landing site for the Zhurong rover – the last, and largest, of the three missions arrived at Mars, in the form of NASA's Perseverance lander. It touched down in the Jezero Crater, near what appears to be the site of a past river delta, making it a great place to study the history of water on the Red Planet and its potential past habitability.



Soon after this shot was taken, two drilled sample-collection holes would appear in 'Rochette', the grey rock in front of Perseverance

Perseverance is closely based on the design of its predecessor, Curiosity, but has one major addition – a suite of instruments dedicated to drilling and storing rock samples from the Martian surface. But although Perseverance is a highly equipped robo-geologist, there's only so much you can pack onto a rover and send to Mars. To truly understand the planet (particularly if we want to find evidence of any past life) scientists need to be able to study a Martian sample in the best labs here on Earth. Perseverance represents the first step in that process. It will spend the next few years travelling across Jezero Crater, collecting up to 43 rock samples that it will then leave in caches for a future mission (currently being planned by NASA, in collaboration with the European and Japanese space agencies) to collect and return to Earth.

Perseverance attempted to collect its first sample on 5 August, only to discover the next day that the sample vessel was empty, as the rock appears to have crumbled as Perseverance pulled it out of the ground. The rover moved

to a more solid-looking rock, nicknamed Rochette, and successfully stored its first sample on 7 September.

At the time of writing the rover had travelled over 2.6km – quite a fast pace for a Martian rover. Its progress has been aided in large part by a spacecraft that hitched a ride to Mars with Perseverance: the Ingenuity Helicopter. The small drone-like rotocraft is a technology demonstration mission, intended to see if it's possible to fly through the thin Martian atmosphere, the answer to which is a comprehensive 'yes'. Since its first 39-second test flight on 19 April, Ingenuity has flown over a dozen times, travelling more than 2km.

More elaborate missions using the same technology are being planned, but as Ingenuity is only equipped with a camera, it's being used to scout ahead of Perseverance, highlighting any potential hazards or objects of interest.

So what have we learned at Mars this year? The UAE learned how to orbit, China learned how to land, and NASA learned how to fly. **SF**



Jezero Crater, as seen by ESA's Mars Express orbiter, before NASA's Perseverance began exploring the area