Why humans must not give up the quest for Mars

It’s costly, but by exploring the red planet, we may yet solve mysteries about space and ourselves

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When US president Donald Trump called astronauts aboard the International Space Station last week to congratulate Peggy Whitson, who now holds the record for the most time spent in space by a Nasa astronaut, he also asked when he could expect to see humans land on Mars (answer: the 2030s). “Well, we want to do it in my first term or at worst in my second term,” he joked, “so we’ll have to speed that up a bit.”

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Nasa's not alone in its mission. Space agencies worldwide are aiming for Mars, and the coming decades hold numerous plans for manned and unmanned missions. Although other worlds in the solar system hold significant scientific promise (not least Saturn's moon Enceladus, which hosts a salty underground ocean and was found to have almost all of the ingredients needed to support life as we know it about a week ago), it seems that we just love Mars the most. Too much? I don't think so.

Mars is an especially good mission target due to its proximity to us, and has been easy to see in the sky since the year dot; it is relatively similar to Earth in a number of crucial ways, making it a better bet for manned missions and potential colonisation than any other planet in the solar system. There is still much we do not know about the planet – and so much science to be done there.

We have loved Mars for centuries. The planet has firmly embedded itself in our culture, so much so that "Martian" is somewhat synonymous with "alien" – although the aliens you imagine, from sleek black obelisks to giant Wellsian tin cans or little green humanoids, may vary.

Science-fiction authors – Isaac Asimov, Ray Bradbury, Arthur C Clarke, HG Wells, John Wyndham, Robert A Heinlein, Kurt Vonnegut, Philip K Dick – have penned thousands of pages about the red planet. Enormously influential albums have described otherworldly rock stars with backing bands of Martian spiders. A story about an astronaut (played by Matt Damon) cultivating potatoes on the surface of Mars became a Hollywood blockbuster in 2015, raking in $630m at box offices around the world. All manner of television programmes have found inspiration in Mars, from Captain Scarlet to Looney Tunes' hapless Marvin the Martian.

This cultural interest is mirrored in scientific interest. Our first mission to Mars launched in 1960, and we have attempted more missions to the planet than to anywhere else in the solar system bar the Moon. Given this history, you'd be forgiven for thinking that we must know almost all there is to know about Mars by now – but that's not the case. For one, we're still unsure of how Mars formed. The planet is surprisingly small, and doesn't fit into our models of how the solar system came together. We're not sure how its two small moons formed, either. These lumpy, bumpy rocks have puzzling properties. They may have formed in orbit around Mars, they may be captured asteroids, they may be the result of a giant, shattering impact that knocked material from their parent planet – or something else.

We also lack a complete understanding of Mars's history. We see signs of past water all over its surface and in its chemistry, and so think it was once much warmer than it currently is in order to support liquid water. However, we're not sure how this waterworld changed into the arid lump we see today. To support widespread water and warmth, Mars's atmosphere must have been very thick during the planet's youth (likely facilitated by a far stronger magnetic field, which has long since switched off). Where did it all go?

Then, of course, there's the question of life. Is the planet habitable? Is there, or was there ever, life on Mars? We don't know enough to be sure either way. Perhaps dormant microbes lie buried deep in the soil, or are thriving in warm underground aquifers away from prying eyes. Perhaps the planet is lifeless and always has been, or life has died out.

Uncertainty aside, there is quite a bit we do know about Mars – after all, we have been visiting for more than 50 years. Many of Mars's positive attributes are similar to those of our home planet (rockiness, proximity, familiar features), placing it at the top of the colonisation list. To learn more, we need more data from both our current missions and those launching in coming years.

Arguably the most famous Mars missions are Nasa's rovers: Sojourner (launched 1996), Spirit, Opportunity (both 2003), and Curiosity (2011). The latter two are still active. There are six other active missions collectively studying Mars's properties and potential habitability, namely Nasa's 2001 Mars Odyssey, Maven and Mars Reconnaissance Orbiter, India's Mars Orbiter Mission (known as MOM or Mangalyaan), and the European Space Agency's Mars Express and ExoMars 2016 Trace Gas Orbiter.

Mars is set to get pretty crowded in the next decade. Europe and Russia will soon launch ExoMars 2020, a rover-surface platform duo that will seek signs of biological activity. India aims to launch a follow-up to Mangalyaan in 2020, and the same year will see launches from China and the United Arab Emirates. Nasa will launch a lander to probe Mars's interior, and the Mars 2020 rover, which will not only try to figure out if Mars is (or was) habitable, as Curiosity is doing, but will also hunt explicitly for signs of life. The US agency is also planning manned missions and an eventual landing on Mars in the 2030s.

Despite the uncertainty over scientific funding in the US, Trump appears to support Nasa's focus on Mars. In March, he signed an authorisation bill that secured $19.5bn in funding for the agency, directing it to focus on deep space and a manned landing. However, PayPal billionaire Elon Musk's SpaceX

could beat Nasa to it. Musk hopes to use his fortune to build a human colony on Mars in the 2020s, starting with unmanned supply launches every couple of years from 2018 and a manned launch in 2024 (landing in 2025). However, Musk is famously ambitious with his timelines; he has altered them multiple times, and admitted a fair amount of luck will be needed to achieve them.

There are, understandably, many differing opinions – not all of them positive – on the idea of focusing so much of our effort on Mars. Travel to the red planet threatens to be incredibly expensive, and publicly funding such programmes may suck money from other areas of scientific research. There are also numerous hurdles to clear (technical, biological, financial, ethical) before we can entertain the idea of feasibly sending humans there, whether it be a one-off fly-by or Musk's Earth-Mars shuttle run. Some scientists believe there are more interesting locations to explore: Saturn's moon Titan; Jupiter's moons Europa, Callisto and Ganymede; or Enceladus.

However, Mars is our neighbour, and part of the only planetary system in the universe known to harbour life – us. The red planet may hold the secrets to how our own rocky planet formed, evolved, developed life, and more. It's hard to overstate how sending humans to Mars would further our research: there really is only so much we can do with robots.