

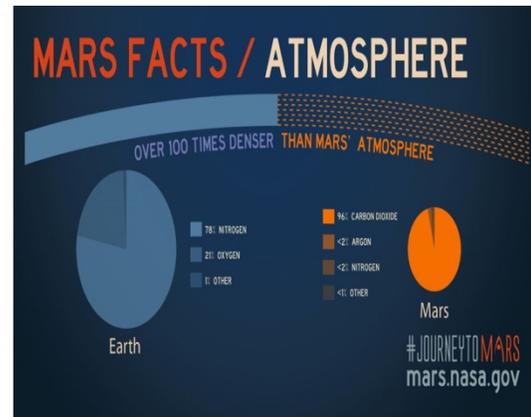
Mars: A prospect for settlement

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The exploration of Mars was once left to the imagination. However, in recent years, the topic of exploring Mars has become more realistic and increasingly popular in news articles and scientific communities. Technology developed in the previous half-century have already allowed humans to send rovers to Mars in order to retrieve some basic data about the planet. Current technological advancements are resulting in reusable rockets that could one day travel between Earth and Mars. Exploration and colonization of Mars are important for the development of research on the planet and the search for life. Current data is limited, but shows that the conditions on Mars could have supported life in the past. To further our knowledge of the red planet, organizations like NASA and companies like SpaceX are developing plans to colonize Mars. Many obstacles stand in the way before humans can reach and colonize the red planet. However, Mars is the best option for interplanetary colonization and the most feasible way to research current and future life on a planet other than Earth.

Mars (4,220 miles in diameter) is approximately half the size of Earth (7,926 miles in diameter). Thus, objects on the surface of Mars would experience 62.5% of the Earth's gravity. The red planet is the fourth planet from the sun, following Earth, at up to 128,409,598 miles. As one moves toward the sun, temperature and radiation increase. The opposite is true if one moves away from the sun. With a proper atmosphere, only certain distances from the sun are habitable. If a planet is too far away, life could not survive the low temperatures and if a planet is too close, the heat and radiation would kill everything. In our solar system, Mars (-284 to 86 degrees Fahrenheit) is the closest planet in terms of temperature range to Earth (-126 to 136 degrees Fahrenheit), indicating that humans and other forms of life may be able to survive on the surface, possibly with provided protection and resources (Mars Facts). Although Mars appears to have once been able to support life and is the most promising planet to colonize, much of the necessities to support life are currently missing. In the future, terraforming to alter the atmosphere and air composition of Mars may make the planet fully habitable. However, terraforming is simply a theory and has never been put into practice. Altering a planet's atmospheric composition could be much more difficult and time consuming than expected.



The atmosphere surrounding Earth is nearly one-hundred times denser than that of Mars and its composition is crucial to life. According to NASA, the Earth's atmosphere is comprised of 78% Nitrogen, 21% Oxygen, and 1% Other. On Mars, the sparse atmosphere is comprised of nearly 96% Carbon Dioxide, less than 2% Argon, less than 2% Nitrogen, and less than 1% other gases (Mars Facts). Most of the other planets in our solar system have toxic atmospheres. For example, Venus has a dense atmosphere that is filled with extremely deadly sulfuric acid clouds (What). Clouds as toxic as sulfuric acid have not been found on Mars, yet dangerous toxins still exist on the red planet. The main chemical of concern is Perchlorate. A high presence of perchlorate indicates two things, one good and one bad. The good news is that perchlorate is important for the survival of some microbes that undergo respiration in the absence of Oxygen, indicating that microbes may exist on Mars. Such microbes exist on Earth and can be readily studied. The bad news is that perchlorate exposure has negative effects on humans; it blocks the uptake of iodide by the Thyroid gland. If conditions were controlled to maintain human safety, Perchlorate could be used to colonize Mars. The perchlorate present on Mars could be used to feed microbes that use it for respiration. In return, the microbes would produce oxygen as a byproduct of respiration and energy could be harvested from the microbes in the form of "microbial fuel cells" (Anderson). Although it is extremely important, atmospheric content is not the only thing crucial for supporting life on Mars.

Supporting the growth of vegetation on Mars is a massive undertaking. Besides an atmosphere similar to Earth's, plants need essential nutrients and plenty of water to grow. Earth contains large amounts of essential nutrients within its soil, allowing massive amounts of plant growth. Imaging shows that Mars most likely had water on its surface at one point and there is evidence that water exists as ice, flowing water, and vapor on Mars (Anderson). This is one of the main factors that makes Mars exploration a promising endeavor. Rovers, such as



NASA's Curiosity rover, have shown that the nutrients needed for plant growth have been found in Martian soil or in Martian Meteorites (Jordan). Plant growth can play a crucial role in terraforming Mars to create a more hospitable atmosphere. Data has shown that Mars has the potential to one day support life. The next step is developing the technology and support to take life to Mars.

Three large organizations are competing for the colonization of Mars: NASA, SpaceX, and Mars One. Let's explore the motives driving each competitor. NASA has had the lead on the Mars race, seeing that they have already been collecting data with Mars rovers and probes. As with any NASA mission, the main goal is research. Similar to the moon landing missions, NASA wants to send humans to Mars in order to collect detailed data that robots simply cannot collect, like the effects of Mars on humans. NASA is currently observing the effects that living in deep space has on humans and plants on the International Space Station (Herridge). The research is vital for transporting life forms to Mars and helping them colonize. SpaceX has been developing rockets that can leave earth, and safely return on a landing pad; the company has also released plans to

reach Mars by 2020. Their current main goal is to significantly reduce the cost of transporting people and materials to Mars, seeing that the current hopeful estimate to take a person to Mars is \$10 billion per person (Mars). The motive behind SpaceX's mission is simple. Elon Musk, the founder of SpaceX, wants to explore and eventually develop a self-sustaining city on Mars. While SpaceX has been showing promising technological advancements, Mars One seems to be stuck in a concept phase. The company was founded in 2012, and has publicly released a full plan to reach and colonize Mars by 2032. Although they have detailed plans, they have not truly proven themselves as competitors to SpaceX. Instead, Mars One may rely on the Falcon series rockets developed by SpaceX to reach Mars. Lastly, Blue Origin seems to be building rockets that can compete with the likes of SpaceX. There is speculation that Blue Origin will eventually enter the Mars race. However, they have not officially announced plans to do so.

Data has supported that Mars may have once supported life and that it can one day be colonized and potentially changed to support life. Mars is close to Earth and maintains a temperature similar to Earth. Like Earth, Mars contains frozen, liquid, and gaseous water. However, it has not been observed to be nearly as abundant. Although the Martian atmosphere is sparse compared to Earth and incapable of supporting most life forms present on Earth, terraforming could possibly change the environment of the red planet. Mars also has the added benefit of lacking any highly toxic clouds like Venus. It does have a high presence of Perchlorate, but the presence of perchlorate may prove to be an advantage for oxygen and energy production via the use of microbes that use Perchlorate for respiration. Research conducted by NASA has also shown that Martian soil contains nutrients vital for supporting vegetation, which could in turn be used for terraforming. Now that data has shown the potential of developing life on Mars, organizations must develop the technology and support necessary to reliably send people to Mars. NASA, SpaceX, and possibly Blue Origin have already made technological advancements that are getting humans closer to reaching Mars. Companies like Mars One are developing and planning the technology needed to colonize Mars. If all goes well according to plan, Humans may set foot on Mars in the near future.

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