

The Comparison of Venus and Mars in relation to Terraformation

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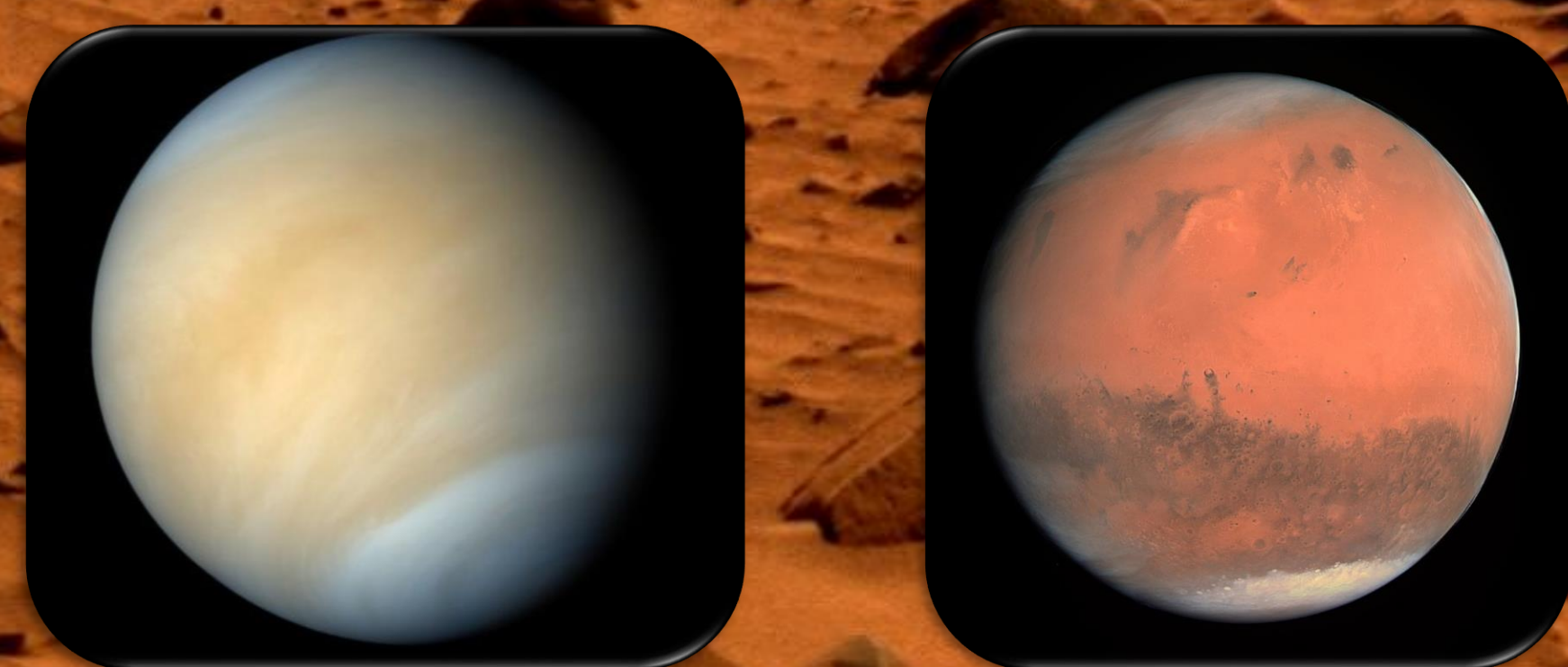
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Abstract

The deterioration of Earth due to overpopulation, pollution, the increase in greenhouse gases in the atmosphere, and other conditions, is prompting the research of possible migration opportunities to other planets. Considerable, plausible futures for planet Earth end at the elimination of any forms of life currently present on its surface, in its atmosphere, or in its oceans. The emigration of the human race to another cosmos is inevitable especially considering the rapid decline of the planet today. Two such probable habitable worlds include Venus and Mars, the second and fourth planets of our solar system, respectively. Temperature, pressure, atmospheric climate, surface climate, distance from the sun, and other such variables require key investigation to verify a possible life-affirming future for either Venus or Mars. This takes into account various fields of study, including geology, planetary science, meteorology, astronomy, spectroscopy, biology, and chemistry. To an outsider, the dry, rocky surface of Mars and the hot, sulfuric atmosphere of Venus mean that life could never survive, never mind thrive on either planet. However, further research indicates that with certain modifications, habitation on one, or both, planets is entirely possible. With a thorough analysis of the past climates of both planets, it is seen that in their early histories, both possessed environments that could very likely be home to many unknown, undiscovered, and unexplored life forms unimaginable to the human mind today. Evidence of bodies of water and a sustainable atmosphere for both planets has been found leading to additional, detailed research on potential futures for both Mars and Venus. Upon further analysis, researchers came to the conclusion that the surface of the Martian planet is more habitable, not its atmosphere, and visa versa for the Vesuvian planet. Several more differences between the two prove how possible a future home on either planet could be.

Introduction

- Venus and Mars, the second and fourth planets, respectively, are two such probable habitats for some sort of life form in the near to distant future
- A **habitable zone** is orbital region around a star in which an Earth-like planet can possess liquid water on its surface and possibly support life.
- Terraforming** refers to the hypothetical process of deliberately modifying a planet's atmosphere, temperature, surface topography, or ecology to be similar to the environment of Earth to make it habitable by Earth-like life.
- Terraforming is the **first step** for both Venus and Mars to become potentially habitable in the next 10, 100, or 10,000 years.



Results

- Earth's future can lead to a **Venus-like planet** or just a **desolate** one.
- The **need for human migration** to a different planet is becoming more necessary as our Earth slowly deteriorates from pollution, increase in greenhouse gases, climate change, and overpopulation.
- Each planet has gone through its own evolution in environment and climate that brought it to what it is today.
- In a similar case, each planet must go through its own modifications and journey to become another Earth-like planet for humans to live on.

Materials and Methodology

Possible Futures for Earth

- Slow increase of greenhouse gases will eventually lead to increased trapping of infrared radiation that would increase the surface and atm temperatures of the planet.
 - End result: Venus-like planet**
- Deconstruction of Earth's magnetosphere will lead to lack of atmosphere. Oxygen will be stripped away leaving nothing but sulfuric clouds and increase in harmful ultraviolet radiation.
 - End result: dark, desolate planet**

Table 1. Major data of the orbits of Venus, Earth, Mars and Jupiter

	Venus	Earth	Mars	Jupiter
M/M _E	0.82	1	0.11	317.89
e	0.007	0.017	0.093	0.048
R (AU*)	0.7233	1	1.524	5.203
i (deg)	3.40	0	1.85	1.30
T (years)	0.62	1	1.88	11.86

* AU = Astronomical Unit

Similarities between Earth and Mars

- Mars has the same rotation rate as Earth = **similar force of gravity**. In addition, the distance from the Sun to Mars is nearly **1.52 times the distance** from the Sun to Earth.
- The amount of sunlight Mars receives is **43% of terrestrial value**.
 - more than enough for **photosynthesis** to occur
- Surface temperatures reside in same range
 - Mars: -30° C || Earth: 15° C**

Similarities between Earth and Venus

- The surface of Venus can, in no shape, sustain Earth-like life, however the **atmospheric conditions** stay relatively the same, with little to no change.
- About 50 km from the surface, the atm pressure is **one bar**, which is equal to the pressure of Earth's surface.
- The atm is **Earth-like above the clouds**.
 - In this zone, the temperature resides to about 350K, decreasing to 263 K, 10 km above that.

Theory and Calculation

Mars – Past and Present

- Evidence shows that early in its history, the Martian planet once possessed a warm, wet climate that may have been suitable for primitive, biological life forms.
- However, over time, Mars's atmosphere grew slowly colder in certain areas as the water from up and formed ice and CO₂ dominated the air.
- Mars lacks any sort of magnetosphere. A magnetosphere is the region surrounding the Earth or another astronomical body in which its magnetic field is the predominant effective mf.

Venus – Past and Present

- Around 4 billion years ago, the sun was about 25% less luminous than it is today. Temperatures on Venus's surface must have been significantly less, maybe even in the range of potentially habitable.
- Venus also lacks a magnetosphere. Its present ionosphere is responsible for the separation of the atmosphere from solar winds and other features of outer space.

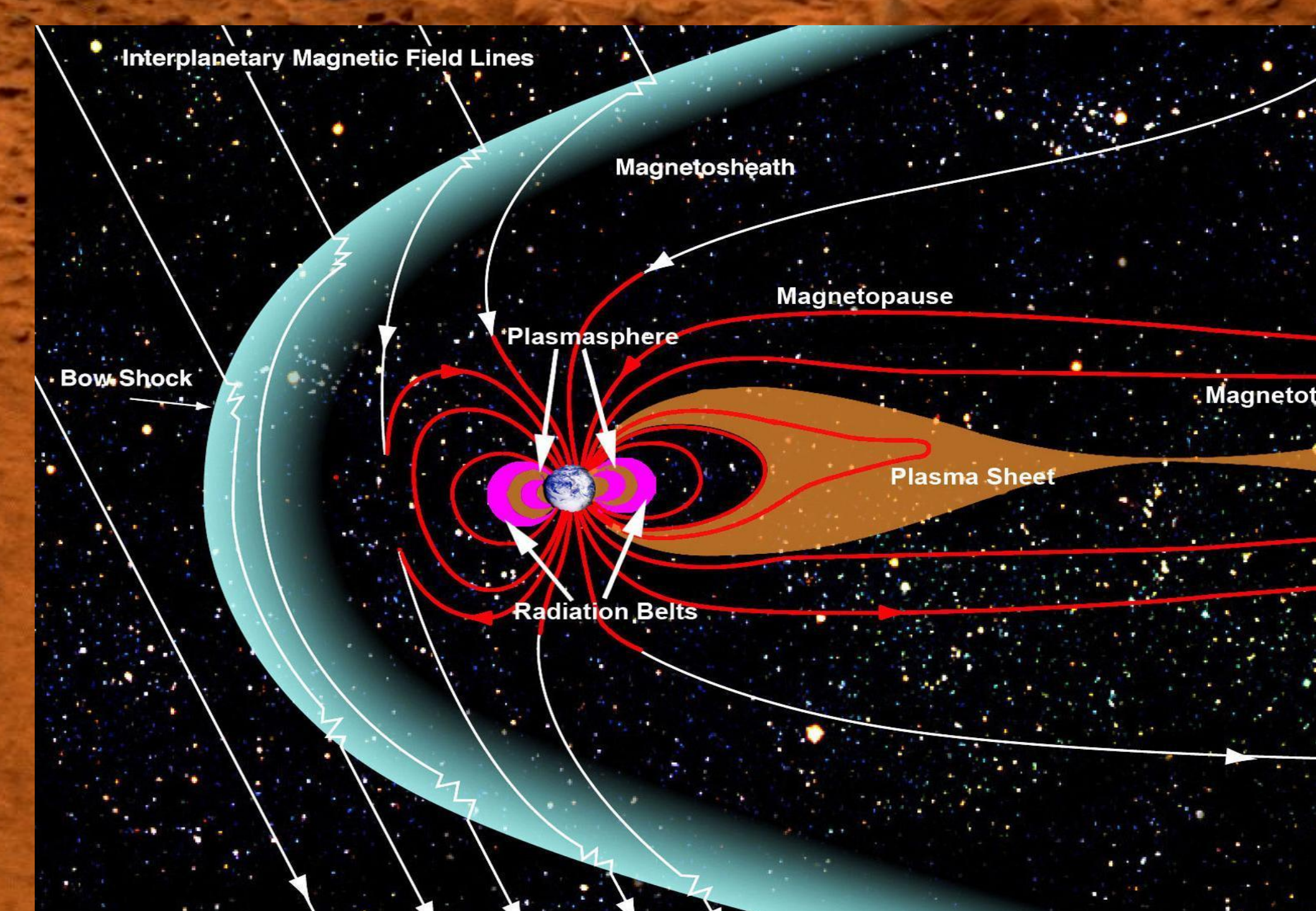
About the Author || Acknowledgements



Studying at Embry Riddle Aeronautical University, Riya Joshi is working towards a Bachelor's in Aerospace Engineering with a focus on Astronautics and a minor in Applied Mathematics. She has published her research and presented it at the International Astronautical Congress (IAC) in Bremen, Germany in October 2018.

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Discussion/Conclusion

- Venus:** requires a form of life adapted to harsh environments on Earth.
 - Extremophiles** (*thermophiles* [beyond boiling point] and *acidophiles* [pH level of 3])
- Life can thrive in the **clouds** (bacteria was known to exist in Earth's clouds)
 - Hyper-acidophilic bacteria**
- Mars:** **Ecopoiesis** is human controlled process consisting in changes needed for anaerobic life to be established on planet surface
 - Airtight biodomes** with synthesized oxygen and anaerobic bacteria