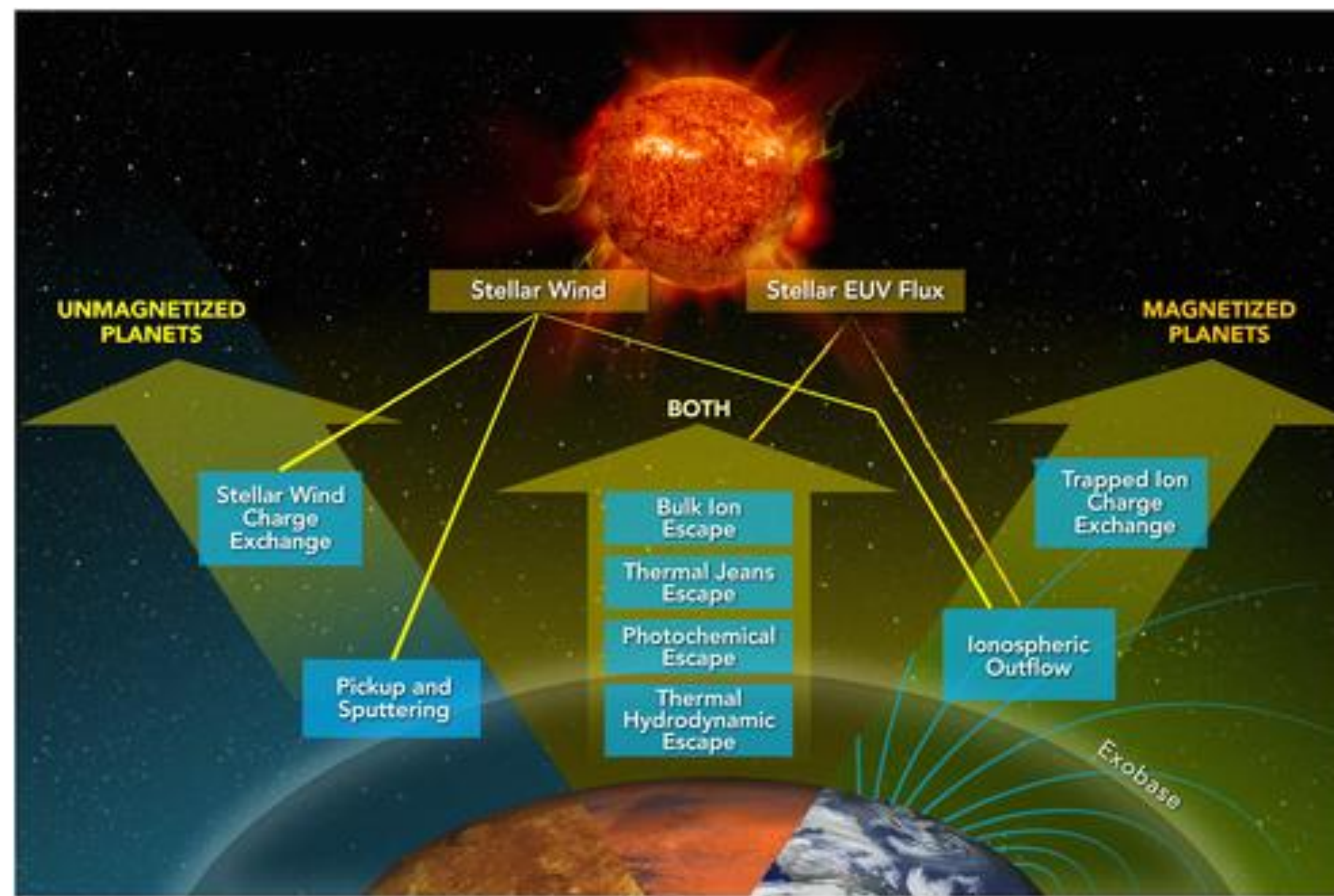


## Abstract

- Colonization of Mars is not so out of reach today. Research shows that there has been water on Mars which indicates life could have been on Mars in the past or that Mars had features to sustain life. However, currently Mars is not habitable to life as we know it.
- I've identified three main challenges that need to be solved to make Mars livable: an atmosphere that provides oxygen and a greenhouse effect, a source of heat that compensates for the planet's far distance to the sun, and water.
- In this project, scientific solutions to these challenges such as thermonuclear mining and the creation of an artificial atmosphere, are critically evaluated, and a "best path forward" is to completely build a totally artificial atmosphere instead of making ways for Mars to develop its atmosphere "naturally."



## Beginnings of Artificial Atmosphere

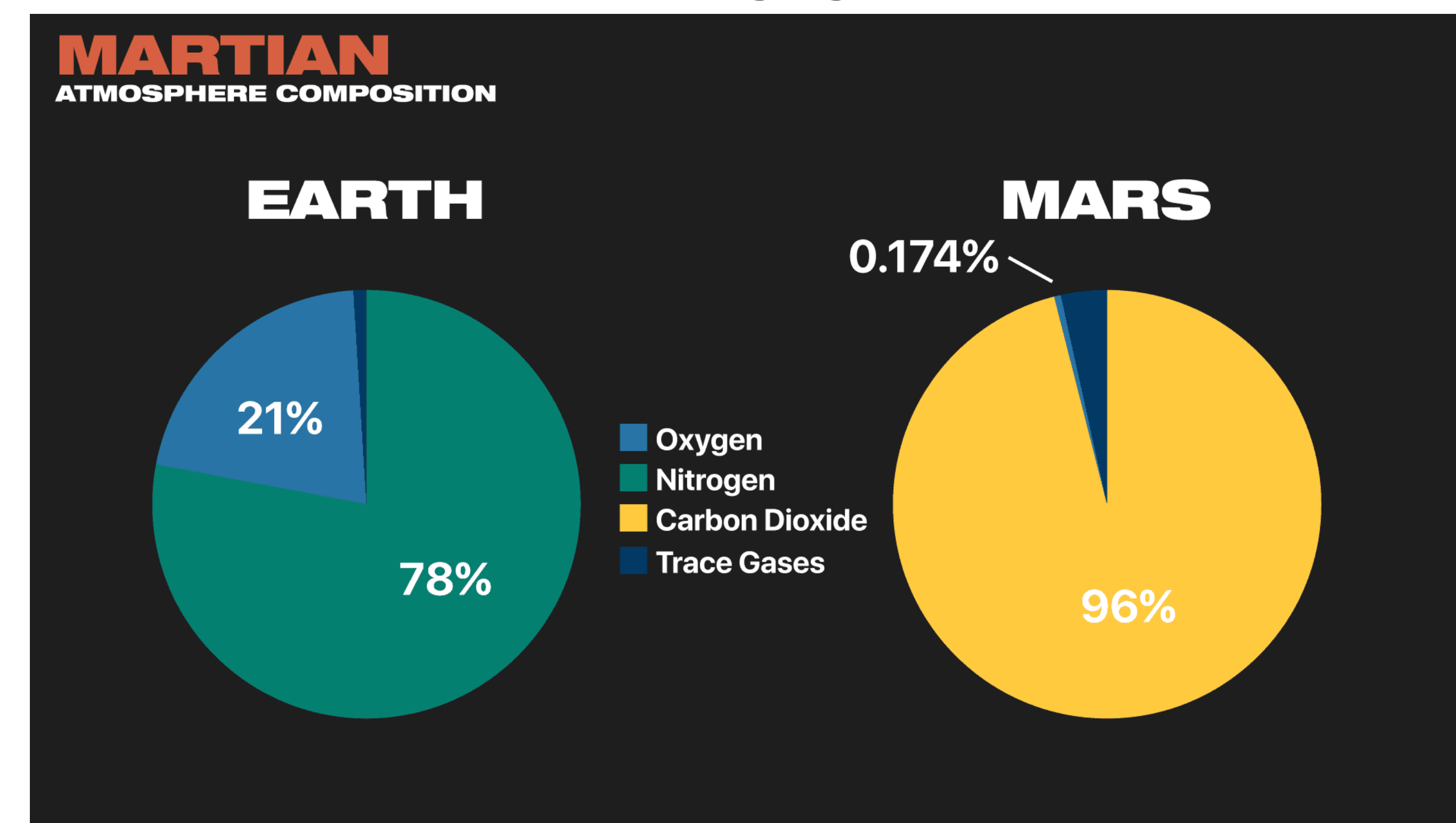
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### Introduction

Earth is habitable because it has, water, oxygen, and an atmosphere. The atmosphere protects the planet from the sun's harmful radiation, solar winds and provides warmth. Earth's atmosphere contains greenhouse gases like carbon dioxide that help earth maintain a surface temperature/ environment that is able to support life. For this study, the focus is Mars: Mars is very similar to Earth in dimensions but greatly different in atmospheric composition. The axial tilt of Earth is 23 degrees and Mars' 25.19 degrees. Then when it comes to their atmospheres, "Earth's atmosphere is 78% nitrogen, 21% oxygen, 1.0% argon, 0.04% carbon dioxide, and small amounts of other gases. It also averages about 1% water vapor. Mars' atmosphere however is 95% carbon dioxide, 3% nitrogen, 1.6% argon, and it has traces of oxygen, carbon monoxide, water, methane, and other gases, along with a lot of dust." (Mars Education, Arizona State University) Even though Mars is similar to Earth in a number of ways, Mars has a lot of crucial differences that make it challenging to make habitable.



## Conclusion

This is no easy task however I can start with what I know is needed to create it. A power source will be a big challenge. There needs to be a way the atmosphere can be self sufficient or at least have a long lifespan. The initial idea: can we use nuclear waste or power to sustain an artificial atmosphere? And it does not have to encompass the entire planet but a small area. Mars needs heat, a stable temperature that is able to contain liquid water on the surface. The artificial atmosphere would also have to have a mechanism where the water cycle can occur naturally. In addition, one must take in account the atmospheric escape, the artificial carbon sequestration process and there are an amplitude of variables that must be taken in account to make an artificial atmosphere, but these are some of the main tasks at hand. Science is advancing everyday and the minds of dedicated scientists and researchers will never cease. The rehabilitation of Mars is underway.



### 1. Change Albedo

Mars must be warmed to 273K to maintain liquid water on the planet. An idea was proposed to volatilize the polar caps ending the Martian "ice age." Doing this would increase the absorption of solar energy by covering the polar caps with  $10^9$ - $10^{10}$  tons of low albedo dust. Low albedo objects are things that reflect very little incoming radiation and absorb the majority of the energy; for example, concrete, forest, dirt. As a result, the planet would absorb more solar energy, resulting in a warmer planet.

### 2. Chlorofluorocarbons

CFC's are also classified as halocarbons and this is essential because some molecules that have covalent bonds are hydrogen, nitrogen, chlorine, water, and ammonia and these are molecules that are necessary to produce a breathable atmosphere. Also, CFC's and hydrofluorocarbons act to trap heat in the lower atmosphere, specifically infrared radiation. This mechanism would be beneficial to aide in heating Mars.

### 3. Thermonuclear Mining

• Thermonuclear mining needs a very high temperature for their inception (like in a hydrogen bomb or the sun) this is a thermonuclear reaction through a thermonuclear weapon. This was suggested because it would devolatilize the rock on Mars exposing carbon and other needed resources to sustain life. For example, thermonuclear mining for an atmosphere could also serve to release water rapidly and release quantities of nitrogen and nitrogen encompasses 78 percent of earth's atmosphere so we can infer that it is very important in an atmosphere on Mars. However, the reason thermonuclear mining is deemed ridiculous by some is because the quantity of nuclear weapons needed. It is stated that 10,000 nuclear weapons are needed to terraform Mars.

### 4. Magnetic Field

Magnetic fields are essential for they protect a planet from solar winds, harmful radiation, and aids in acquiring atmospheric equilibrium. If we were to excavate the carbon enriched rock on Mars, the CO<sub>2</sub> would have a chance of escaping into space. This is the reason a magnetic field is important, to keep the atmosphere on the planet.