SASTA OLIPHANT SCIENCE AWARDS

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Year 7-8

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Wilderness School

Government of South Australia
Department for Education

SASTA South Australian Science Teachers Association

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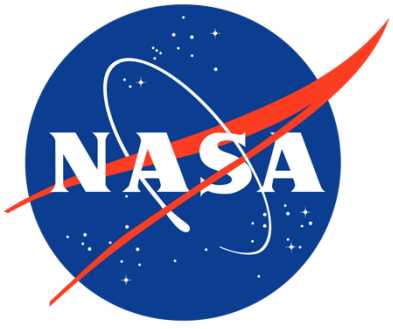
Introduction

Dear Australian Space Agency,

In the historic conflict of the Cold War, Soviet Union and USA exchanged threats, had non-violent face offs and raced to make new scientific discoveries. But now we are entering a different Cold War. NASA, Space X, ISRO, CNSA, Roscosmos and The Australian Space Agency are all racing to build bases in space.

For 5 years, I have worked with NASA helping them with their Mars missions, but as the space race gathers pace, we must decide our loyalties. I long to return to my sunburnt country, Australia, and I hope you will assist me in doing so by allowing me to assist you in this race. I have compiled my findings in the following document - *The Mars Files*, which shall give you a glimpse of my potential role in Australian Missions to Mars.

Yours Sincerely,
~Dr Karly



Why Mars?

Why are we seeking to live on Mars? The human race has had taken a toll on the Earth over the years, and if factors like climate change and population continue to ruin our planet, we must seek new planets to live on. Out of all the seven planets, Mars is the most reasonable choice. It is close to the Earth; it might have had water on it, and its structure is similar to that of Earth.

It is interesting to note that the word ‘Mars’ originates from the Roman God of War- Mars. And now Mars is the space frontier that the countries of the Earth are fighting a space war to conquer.

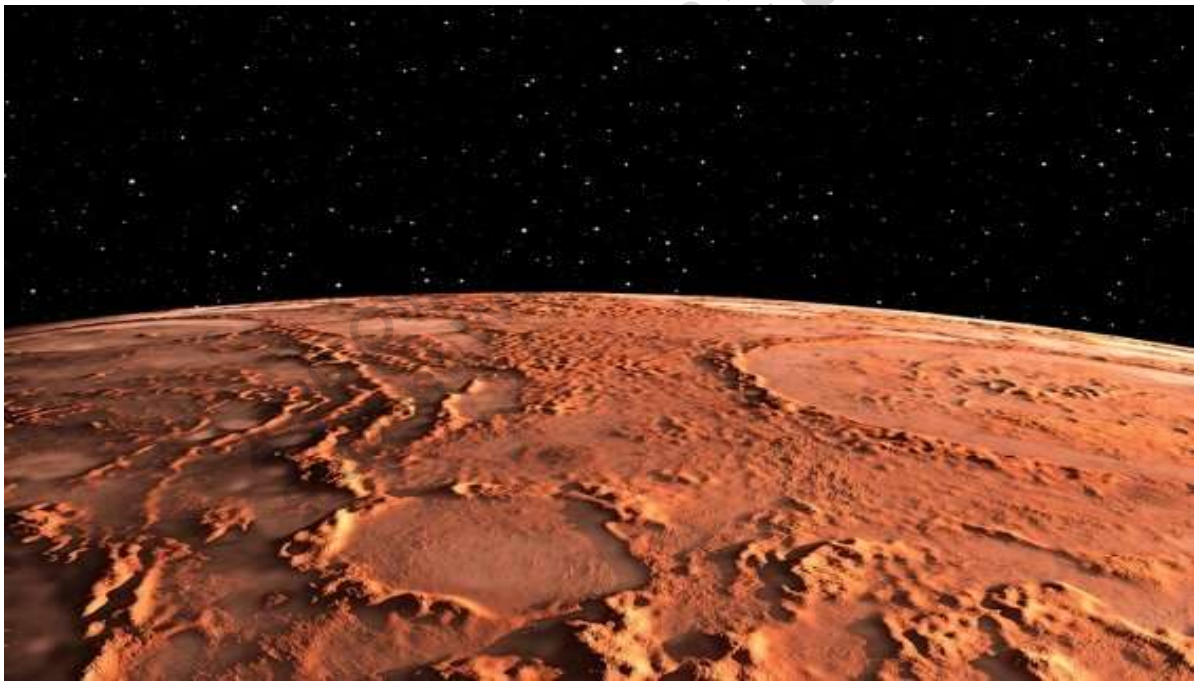


Figure 1.0- https://phys.org/news/2020-05-astrobiologists-mars-rover-life-detecting-equipment.html

Sustaining and Growing Plants on Mars

The very first thing that all space agencies looked at in the space race was the capacity for plants to survive and germinate on Mars… but why? Animals rely on plants to give them the necessary nutrients and proteins to live. Even carnivores rely on plants as they eat herbivores who consume plants as their diet. So, humans rely on plants for their existence

But what do plants rely on for survival? Plants mainly rely on Nitrogen, Potassium and Phosphorus to survive. Fortunately, all of these elements are present in Martian Soil. But Martian soil also contains an abundant amount of Calcium Perchlorate, a highly toxic salt that can be fatal to both plants and animals. Luckily, NASA has found an easy but strenuous solution. Like most perchlorates, Calcium Perchlorate rises to the surface of the soil that it is a part of when water is added to it. This makes it easier to separate. However, it is a complex process and it is water intensive.

In Mars, the atmosphere is mainly made up of Carbon Dioxide (CO_2). Since this is necessary for the plants' survival, this is excellent, but Mars is extremely cold, and there is almost no light, because Mars is further from the sun than the Earth. Curiosity, our Mars rover discovered that the average Summer day on Mars would reach 20°c and the temperature could drop to -73°c. Though plants could use Martian soil after it has been processed (as described above), they would have to grow in greenhouses with controlled temperatures and atmosphere.

This is a model design of a greenhouse that NASA plans to implement on Mars. It is made out of titanium to withstand the harsh environment and it has separate chambers for removing the Calcium Perchlorates and for harvesting oxygen that the plants release.

Figure 2.0- https://eos.org/articles/tests-indicate-which-edible-plants-could-thrive-on-mars

The Composition of the Soil and Mars's Structure

Mars is famous for its red soil that is visible from Space. But what elements and substances does this red dirt contain? This prompted NASA's research into the composition of the soil and the structure of the planet itself.

Mars has an intact crust, unlike Earth's that is split into tectonic plates. The crust itself is made up of volcanic basalt rock that also holds various nutrients like sodium, chloride, potassium, phosphorus and magnesium. It is around 30 miles deep. The crust is covered in a fine layer of highly oxidized iron dust which gives the planet its red tinge.

The Martian soil is a large sandy terrain. It contains large portions of volcanic rock, clay and silt. Unlike Earth, the Martian terrain is mainly homogenous (it is the same terrain consistently). This is because of the constant sandstorms that blow the soil throughout Mars. The sandstorms are massive and can harm humans as it carries chemicals like calcium perchlorate which can be fatal. Because of this, at all times we must wear space suits which cover us completely and are thick and strong.

Picture taken by NASA rover- Spirit of the homogenous landscape.

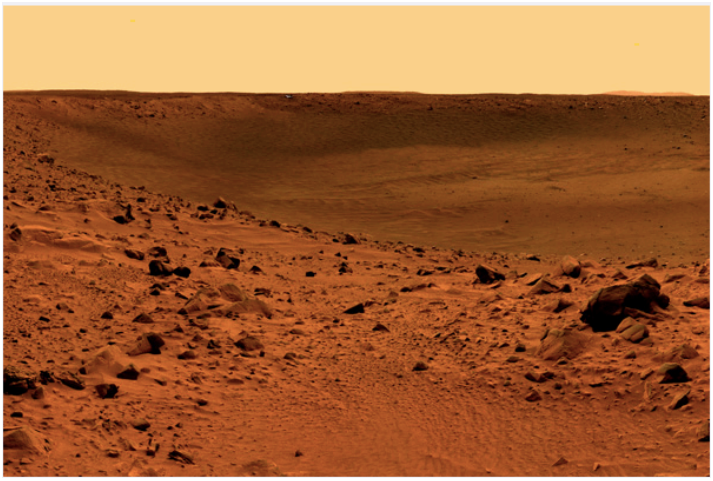


Figure 3.0- https://eos.org/articles/tests-indicate-which-edible-plants-could-thrive-on-mars

Beneath the crust there is a 1100-mile layer of mantle, which contains a lot of magma. This magma builds up pressure over time, and eventually erupts to the surface creating Mars's famous volcanic eruptions. In fact, because both Hawaii and Mars contain large amounts of volcanic rock, scientists from NASA have been able to create simulations of the Martian soil using soil from Hawaii.

The diameter of Mars is 6,790 kilometres which is almost half of that of Earth (12,750 km). Because of its small mass, its gravity is about 38% of that of Earth. In order to stop us from drifting off into space, we will need to wear high-density metals on our feet. I was the one who invented and tested it on Mars's gravity models and NASA named them Karly's Boots!

Another feature of Martian composition in comparison to Earth is that Mars has a lot of Mineral matter but no air, no organic matter and very little water. (Figure 4.0)

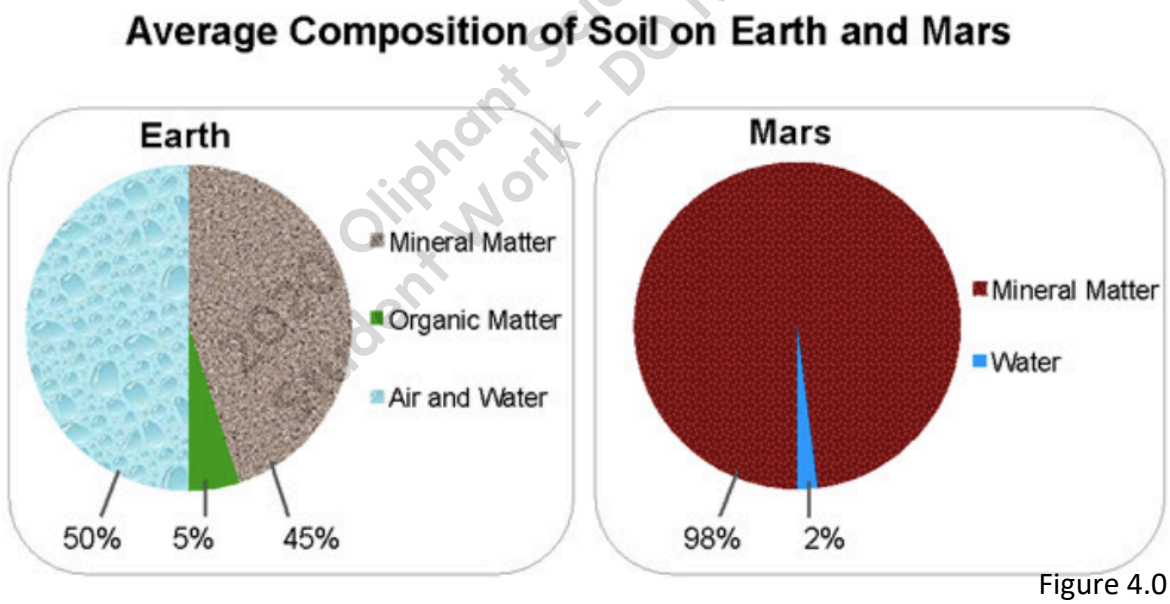


Figure 4.0

To make up for the lack of water on Mars, recycled urinary waste might be a solution. Although it sounds disgusting, recycling urine is environmentally and economically sound. In fact, astronauts are already using this system while they are staying in space and they haven't faced any health issues.

While the Martian soil and crust doesn't have any particular uses for humans, we can use the boiling magma in the mantle to create heat energy to fuel transport, heaters and much more. In 2018, I took part in an experiment where we experimented with the volcanic magma from Hawaii to create heat energy. We had to work fast as the magma cooled quickly but we managed to produce enough energy to power a 2-storey house for 3 days from just 1 volcanic eruption!

Figure 5.0- https://solarsystem.nasa.gov/planets/mars/in-depth/

Composition of the Atmosphere

The atmosphere in Earth has supplied us with all the necessary gasses in right proportions for life. However, can Mars do the same? When we compare the Earth's atmosphere to that of Mars, these are the results.

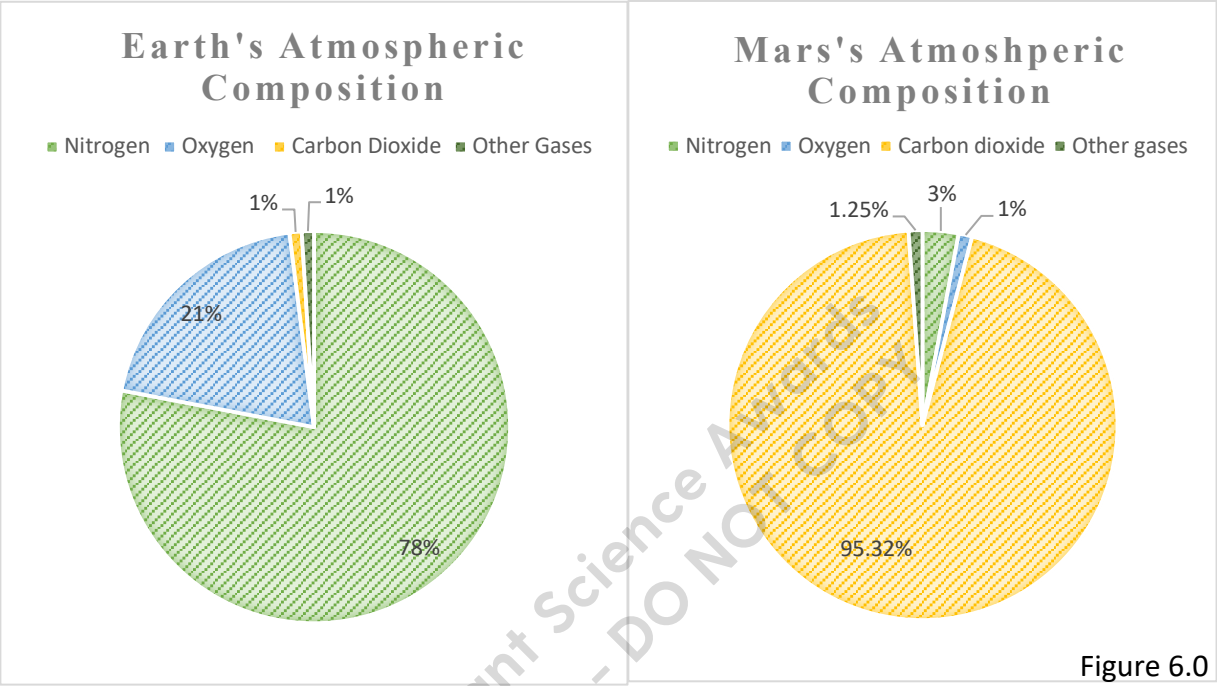


Figure 6.0

As we can tell from these graphs, the composition of the atmosphere in the two planets are very different. In Mars, carbon dioxide is abundant (95%) but almost no oxygen (1%) or nitrogen (3%). This is very different to Earth, whose atmosphere is 78% nitrogen, 21% oxygen and 1% carbon dioxide. As humans rely on the amount of oxygen in the air to survive, living on Mars wouldn't be easy. Carbon dioxide is a by-product of humans and isn't needed for our survival. Luckily, plants need carbon-dioxide and release oxygen as a by-product. So, if we are able to collect the oxygen that the plants we release, and store it, we can use the abundancy of carbon dioxide to our advantage.

The atmospheric pressure between the two planets is also very different. While the atmospheric pressure on Mars at sea level is 6-7 millibars, the pressure on Earth at sea level is approximately 1,013 millibars! That is about 155 times more! This affects us as the atmospheric pressure on Earth is related to the changing weather each day. Mars however has almost no atmospheric pressure, the weather will almost always be cold and windy.

The Earth has a thin layer of gas called the ozone layer which protects the Earth from the Sun's harsh UV light. Unfortunately, Mars lacks this in its atmosphere. The Earth also has something surrounding it called the magnetosphere. This is created by the Earth's magnetic force created by its iron core. When any form of cosmic radiation comes close to the Earth, the highly charged particles in the magnetosphere will incinerate the objects, forming a barrier around the Earth. The lack of these two essential things in the atmosphere exposes Mars to a harsh level of electromagnetic and cosmic radiation.

In order to protect us from the cold, thin atmosphere, UV light, radiation and to provide us with the correct elements in the atmosphere, special pods will have to be made. These pods will have green houses, special coverings to protect us from the UV light, radiation and thin atmosphere and large heaters that will be fuelled from the magma under the crust.

This is an example of the pods that NASA is planning to create. They are 4 storey, cylindrical type structures with a greenhouse attached to the side. It has thick titanium walls, and oxygen produced by the plants constantly flows back into the pods.

If the Australian Space agency is interested in these pods; I can obtain blueprints as I have seen the designs and sketches that the NASA scientists have made.

Figure 7.0-

https://www.cnbc.com/2019/05/24/pictures-nasa-approved-designs-for-3d-printed-homes-on mars.html#:~:text=Take%20a%20look%20inside%20the,hours%20without%20any%20human%20assistance.

Conclusion

If the Australian space agency is excited by my proposal, I would be willing to bring my expertise and passion to help the land down under create the most innovative Martian settlement.

Yours truly,
Dr Karly

Figure 8.0- https://www.rmit.edu.au/news/all-news/2020/jun/locally-

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