

## The Importance of MOXIE to the Future of Space Exploration

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Introduction: With the recent landing of Perseverance on Mars, NASA is making great strides in making life multi-planetary. Missions such as Perseverance aid in not only our understanding of other planets, but our understanding on how to establish life on other planets. This project will explore the technology of Mars Oxygen In-Situ Resource Utilization Experiment (MOXIE) and the potential it holds for not only the Artemis generation, but to future missions. With devices such as MOXIE, we're able to build an understanding for Mars' atmosphere and the potential it holds for life.

Perseverance Rover: Launch: July 20, 2020 Landing: February 18, 2021 Landing Site: Jazero Crater, Mars •The sight of an ancient lake and river delta Projected cost: \$2.7 billion Goal: To search for past life on Mars and to collect soil and rock samples for a future return



Figure 1: Map showing different landing spots of previous Mars rovers and Perseverance

MOXIE: Mars Oxygen In-Situ Resource Utilization Experiment (MOXIE) is a device on the bottom of the Perseverance rover. While MOXIE is only the size of a breadbox, it's able to replicate what trees on Earth do for us: create oxygen. The exact purpose of MOXIE is the ability to intake carbon dioxide (CO<sub>2</sub>) and turn it into oxygen (O<sub>2</sub>). Human exploration to Mars is extremely perilous as there are many differences in atmosphere compared to Earth, such as Mars being 95 percent carbon dioxide (CO<sub>2</sub>). MOXIE can pull the carbon dioxide (CO<sub>2</sub>)  $^{\rm breadbox.}$ out of the atmosphere using a pump and is then lead through an electrochemical process. The electrochemical process works at high temperatures to separate one oxygen  $(O_2)$ atom from each molecule of carbon dioxide (CO<sub>2</sub>). After each molecule is vetted by MOXIE, the gases are released back into the Martian atmosphere.



Figure 2: MOXIE being placed into the belly of Perseverance. MOXIE is the size of a breadbox.



Figure 3: The approximate location of where MOXIE is located on the belly of the rover.



Figure 4: A graph comparing the chemical composition of Mars' atmosphere versus Earth's atmosphere **First Results**: On April 20, 2021, after warming up for 2 hours, MOXIE was able to produce a rate of 6 grams of oxygen per hour. After the first run, MOXIE was able to produce 5.4 grams of oxygen which would keep an astronaut alive for 10 minutes.



**Extrapolation**: MOXIE is vital to the future of space exploration as it carries the ability to make something so crucial to life: oxygen. As discussed earlier, oxygen is a crucial component in keeping the crew alive and the ship having the ability to take-off. While MOXIE is currently being tested on Mars, with the promising results seen, it may have the potential to be used in more missions than just our visits to Mars. A device such as MOXIE will encourage farther and more exciting explorations which can only allow for life to become multi-planetary. Although MOXIE is small, it's inspiring more future generations, not just the Artemis.



Figure 6: Engineer standing next to Perseverance rover which is about the size of a compact car.

## References:

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