Original Work Set-up & Completion Summary

NASA is currently planning a manned mission to Mars. Many individuals wonder why this space agency would risk the lives of men, women, the reputation of themselves and the country. The reason why NASA is risking so much is because of scientific exploration. This is something that has driven mankind forward for many years and will continue to do so for the millenia. With that said, as soon as astronauts take their first steps on the red planet, they will have to start doing a lot of research. One of the biggest questions we have about Mars is " could life exist on the red planet?" One way to get closer to the answer is to study extremophiles. This is what drove me to my original work. I wanted to design an experiment that astronauts can do while they are on Mars. After doing my initial study on Mars' climate, I became intrigued by the limitation of nitrate. Nitrogen is an element that is abundant on Earth. Our atmosphere is mostly nitrogen and we also have the nitrogen cycle. Many of us take this element for granted but it is extremely important for life to flourish. As I was researching the different types of extremophiles, I decided that it would be interesting if astronauts observed the effect of nitrate limitation on these organisms. If these extremophiles somehow show that they fix nitrogen and reproduce, that will be a huge breakthrough in astrobiology. Additionally, I wanted understand how to design a scientifically complex experiment because I will be expected to do it all the time as an astrobiologist.

In order to design this experiment, I had to do a lot of research. I read books on extremophiles, read many research articles, spoke with my mentor and also other experts in the field. To be more specific, I spoke with Dr. Michael Mischna, a martian climate scientist from the Jet Propulsion Laboratory, because I needed to gain information on the components of the Martian atmosphere/environment. He provided me with extremely useful information that allowed me to better design my experiment. I also spoke with Dr. Kathryn Bywaters, an astrobiologist from NASA Ames Research Center. She focuses her research on the nutritional constraints bacterias will face on Mars. We talked about how to effectively design an experiment, what materials will be needed, and how we can measure the data. Talking to these experts gave me a better perspective on what to do for this original work.

Like I mentioned before, I began the process by first getting a good grasp of Mars' environment. It is important to note that I was designing an experiment for Mars and not Earth. After doing this, I created an extremophile analysis chart. This chart would allow me to analyse the different types extremophiles and pick the four

organisms that would best fit the experiment. I looked at the location where the organisms are most commonly found, the temperature range they live in, their nutritional needs, and also their unique characteristics/adaptations. After compiling all the information, I found that Deinococcus radiodurans, Tardigrades, Cryptoendoliths, and Cyanobacteria would work the best for the research.Once I did this, I began to research the instruments that would needed for the experiment. I found that the astronauts would need a mars simulation chamber, a nitrite/nitrate colorimetric assay kit, an epifluorescence optical microscope, and a spectrophotometer. After identifying what instruments I would need, I researched how each of them worked. All of my research allowed me to effectively design an experiment astronauts can complete on Mars.

One thing that I learned while researching is that a mission to Mars puts a severe limitation on how much weight you can take. A large instrument that has a large weight would put the astronauts' lives in danger and jeopardize the entire mission. This forced me to think of alternatives. Even though I have a scientist's mind, I had to think like an engineer too. A scientist needs an engineer and an engineer needs scientist. This allowed me to understand why NASA has engineers and scientists working with each other all the time.

Through this experience, I learned the many small and complicated aspects of the scientific method. In return, I became a better scientist. Also, this original work pushed me out my comfort zone and forced me to think about the engineering aspects of this experimental design.