



CALIFORNIA SCIENCE & ENGINEERING FAIR 2019 PROJECT SUMMARY

Name(s) Catherine Aitken	Project Number S1501
Project Title Effects of Glycerol Solution on Freeze Tolerance and Photosynthetic Efficiency of Cyanobacteria for Use in Terraforming	
<p style="text-align: center;">Abstract</p> <p>Objectives The objective of this research is to further investigation of the possibilities of sustainable life on Mars. This research investigates the efficacy of glycerol as a cryoprotective agent (CPA) in cyanobacteria for use in terraforming the sub-zero degree Martian atmosphere.</p> <p>Methods The research was divided into two sections. The first section consisted of culturing the cyanobacteria 'Cylindrospermum' in an ideal environment, while also culturing the bacteria in varying concentrations of glycerol in a growth medium, to test the effect glycerol has on cell growth. The second section consisted of 2 phases: a flash freeze and a prolonged freeze, both of which tested for glycerol's preservation of cell health and function in temperatures comparable to Mars. The flash freeze consisted of placing samples of the bacteria in varying concentrations of glycerol and submerging in dry ice to test for survival. The prolonged freeze used similar samples in varying concentrations of glycerol, placed in closed frozen bio-chambers with oxygen sensors to record change in oxygen levels over time, as an indication of photosynthetic efficiency.</p> <p>Results The results of the first section exhibited a negative effect of glycerol on the growth of cells. The results of the second section exhibited positive growth in cell health and function, but plateaued after a period of time. The results of both sections supported the original hypothesis that glycerol would not aid growth, but that it's cryoprotective properties can preserve cell function even in a Mars type environment.</p> <p>Conclusions This research shows that, in sub zero temperatures such as Mars, the cryoprotective nature of glycerol will better preserve the health and function of cells with glycerol than those cells without glycerol. Therefore cynobacteria that is protected by a CPA may be effective in terraforming atmospheres of low oxygen and sub-zero degree temperatures. This research helps in advancing knowledge about the possibilities of sustaining life in the harsh atmospheres beyond earth.</p>	
Summary Statement Given the recorded freeze tolerance and photosynthetic ability of cyanobacteria in the presence of glycerol, the project shows that glycerol can be used as an effective cryoprotective agent in terraforming purposes.	
Help Received I created the experiment procedures and carried them out on my own with some explanation of technical procedures (ex. using a vortex mixer) from my biology teacher.	