Abstract
The use of supercritical carbon dioxide (sCO2) in power cycles has been fairly new in the last decade. Due to this, there is a lack in research for both terrestrial and extra-terrestrial applications. The purpose of this project was to utilize sCO2 as a working fluid and design and optimize a Brayton Cycle based heat exchanger on the Martian surface. Carbon dioxide is already found on Mars limiting the need to transport a large amount of working fluid and helping with extra-terrestrial travel. Due to the lack of water on Mars, this research provides a stronger analysis of planetary based dry-cooling processes in low atmospheric pressure and colder temperatures. An in-depth analysis of the heat exchanger was conducted by modeling and validating the changing variables and parameters of sCO2. These include how the density, enthalpy, and kinematic viscosity of sCO2 change due to the pressure and temperature within the heat exchanger. Further research can include designing and conducting an analysis of the inside and outside geometries of the heat exchanger and which materials will be the most appropriate for transportation and efficiency.

Variable Analysis
Since research of sCO2 as a working fluid is fairly new there are not known and published values of many properties. The values of density, enthalpy, and kinematic viscosity were needed for analysis. These values had to be obtained by developing equations based off of pressure and temperature. The properties from the gaseous region of carbon dioxide were used to develop the equations for density and enthalpy. The values of kinematic viscosity from the supercritical region of carbon dioxide were used to develop an equation for kinematic viscosity. Seen in Figure 2 are the values for enthalpy at the gaseous region as well as the linear trend line for each set of temperatures.

Further Research
Further research can be conducted to optimize the design of the heat exchanger and make the analysis model more real world conditions. This includes altering the geometry of the heat exchanger including adding fins to the outside of the pipe. Analyzing different materials to use for transportation and efficiency. Considering environmental conditions including dust storms, altitude, time of day, etc. This research can also continue into an analysis of the different mechanisms of the Brayton cycle including the compressor or turbine.

References