



# CALIFORNIA SCIENCE & ENGINEERING FAIR 2018 PROJECT SUMMARY

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<b>Project Title</b> Evidence of Increased Photosynthesis: Comparing Ratios of Oxygen Isotopes	
<b>Abstract</b> <b>Objectives/Goals</b> The purpose of this project was to discover whether the ratio of $^{18}\text{O}$ to $^{16}\text{O}$ has changed in the atmosphere over time. Oxygen 18 is a stable isotope of oxygen, and the ratio of oxygen 18 to oxygen 16 can tell us about ancient atmospheres. I chose this project because I have heard a lot about climate change, which affects rainfall, farming, and water supply. After some research, I became interested in $^{18}\text{O}$ and how its ratio to $^{16}\text{O}$ can tell humans about past climates. I hypothesized that the ratio has been impacted by human activities over time which influence photosynthesis and climate. I expected to see an increase in $^{18}\text{O}$ in the atmosphere from human activities. <b>Methods/Materials</b> I began by obtaining a modern air sample using an air pump and a two liter flask. I transferred the sample to a pipette, through a trap with liquid nitrogen to eliminate carbon dioxide and water vapor, then into a dip tube in liquid helium at 4 Kelvin for 10 minutes. I repeated this process with an air sample taken in 1974, but first pumped the air from its tank into a pipette at 0.1 liters per minute with a flow meter. I placed the dip tubes in the mass spectrometer for analysis. <b>Results</b> I evaluated about 1,000 measurements with the mass spectrometer. I only used 880 of these measurements because some measurements were contaminated due to accidental fractionation. I made 192 measurements of 2018 air, and 688 measurements of 1974 air. The result of the 2018 air was that the ratio of oxygen 18 to oxygen 16 averaged to be 8 parts per million. The result of the 1974 air was that the ratio of oxygen 18 to oxygen 16 averaged to be -11 parts per million. So, the change is 19 parts per million. I also found that the oxygen value has decreased from 1974. <b>Conclusions/Discussion</b> However, the change of the ratio of oxygen 18 to oxygen 16 was not significant due to fractionation when handling the sample. I cannot conclude that there was a change in the ratio in the atmosphere. If I were to repeat this project again, I would take 10 non-contaminated air samples of 1974 air and 2018 air, without any fractionation occurring. Because the oxygen value has decreased from 1974, my findings show that the depletion of oxygen is consistent with the increase of $\text{CO}_2$ , driving climate change.	
<b>Summary Statement</b> The purpose of this project was to discover whether the ratio of oxygen 18 to oxygen 16 has changed in the atmosphere over 44 years.	
<b>Help Received</b> I had help from my parents to drive me to Scripps Institution of Oceanography at UCSD where I performed my experiment. I was supervised at the laboratory but I completed my experiment by myself. I also received help from Scripps laboratory personnel, Dr. Jeffrey Severinghaus, Alan Seltzer, Benny	