



**CALIFORNIA STATE SCIENCE FAIR  
2017 PROJECT SUMMARY**

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<b>Project Title</b> <b>Variations in Soil Microbial Growth Responses to Climate Change and the Consequences for Carbon Cycle Feedback</b>	
<p style="text-align: center;"><b>Abstract</b></p> <p><b>Objectives/Goals</b> Of all Green House Gases (GHGs), CO<sub>2</sub> causes highest surface warming and shows highest correlation with temperature. Currently majority of CO<sub>2</sub> emissions are from fossil fuels. But while CO<sub>2</sub> emissions from fossil fuels stayed flat during 2013-2016, studies show CO<sub>2</sub> released from soil carbon has been increasing. Soil microbial activity is the best indicator of soil CO<sub>2</sub> emissions. The objective of this project is to study the variations in microbial growth response to an increase in surface temperature in different soil types, depths and land uses to identify the top contributing factors to increase in CO<sub>2</sub> emissions from soil.</p> <p><b>Methods/Materials</b> 3 soil samples each were collected from 6 different land uses, 8 locations in Northern California using a soil core sampler at 2 different depth profiles (3 in. and 12 in.) All 48 samples were tested for pH, N, P, K. From each sample, 2 diluted solutions (1/100 concentration) were created using serial dilution. These 96 solution samples were incubated in Tryptic Soy Agar petri dishes for 72 hrs. under both normal and temperature-controlled surface created using thermostat controlled seed heat mat at 2 deg C higher. The microbial growth in all 96 dishes was measured using CFU count, Microbial surface area and Optical Density</p> <p><b>Results</b> At constant normal temperature, the microbial activity shows minor variations across all soil characteristics, land use types, depths, or soil properties (pH, N, P, K). However, at elevated temperature (2 deg C higher), the microbial activity shows significant variations among the soil types. While most soil types and land uses show moderate changes in microbial growth (range -20% to 100%), forest cover soils show sharp increase in microbial activity (up to 500%) at all depths.</p> <p><b>Conclusions/Discussion</b> A 2 deg C change in temperature causes an average increase of 53% in microbial activity and soil respiration. Based on FAO data, this could mean an additional 0.2 Giga tons of Carbon per year in the atmosphere. Also, FAO estimates current forest deforestation rate is 6 million hectares / year and removal of forest canopy results in a 2-3 deg C increase in surface temperature of forest soil. So deforestation is potentially one of the most important factor in increase of CO<sub>2</sub> emissions from soil carbons (500% higher rate than rest of the land) that in turn causes surface warming leading to a cycle of continued increase in CO<sub>2</sub> emissions.</p>	
<b>Summary Statement</b> Study of the effects of surface warming on soil microbial communities to understand the differences in responses and identify top factors contributing to an increase in soil CO <sub>2</sub> emissions.	
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