



# CALIFORNIA SCIENCE & ENGINEERING FAIR 2019 PROJECT SUMMARY

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<b>Project Title</b>  <b>Effect of Climatic Changes on Plant Growth: A Study of Their Adaptation Patterns</b>	
<p style="text-align: center;"><b>Abstract</b></p> <p><b>Objectives</b> The aim of this research project was to analyze the effect of certain environmental changes on plant growth and their adaptation patterns for survival. This would help us understand how to prepare plants for the future. Our climate is fluctuating rapidly, which is affecting all aspects of our lives. Other than finding solutions to control our climate, we must also prepare to adapt to this crisis. It is important to protect plants from our changing environment.</p> <p><b>Methods</b> This project was split into three main experiments. I constructed a homemade plant incubator. The plants Marigold, Cosmos, Zinnia, and Alyssum were used for their fast-growing nature. In Experiment 1, I grew the plants under various temperatures (95°F and 110°F, 80°F as control) to simulate the rise in global temperature. In Experiment 2, I watered the plants different amounts of water and at different frequencies to represent drought and flood conditions due to global warming and sea level rise. In Experiment 3, the plants were watered with slightly (3000 <math>\mu</math>S/cm) and moderately saline water (6000 <math>\mu</math>S/cm) made from water, NaCl, and CoCl(2) to show soil and water pollution. For all plants, at the end of two weeks, I measured morphological parameters: height, number of leaves, largest leaf area, root length, fresh weight. I performed four trials for each experiment, with around 1500 samples in total. I studied the taxonomic relationships between the plants.</p> <p><b>Results</b> In Experiment 1, the plants had longer roots, more leaves at 95°F, and less leaves at 110°F. Plants grown in drought conditions had longer roots, however, different plants developed different adaptations in flood conditions: Cosmos grew taller while Zinnia produced thicker stems. In Experiment 3, many of the plants germinated but didn't survive for the two weeks.</p> <p><b>Conclusions</b> In water shortages, the plants grew longer roots to reach deeper areas with more water. The plants grew more leaves for more evaporative cooling through stomata, but less leaves if evapotranspiration would dehydrate the plant. Cosmos grew taller to rise above the water level, possibly because of higher levels of auxin, while Zinnia exhibited more secondary growth to resist against water pressures and massive osmotic uptake of water. We can predict that increasing amino acids like proline and varying regulation of hormones like ABA can help plants survive salt stress. We saw that Cosmos and Zinnia plant were the most related out of the four plants. In general, the zinnia plant showed the best adaptive mechanisms.</p>	
<b>Summary Statement</b>  This project aimed towards investigating how plants respond and adapt to environmental stresses, including temperature, precipitation, and salinity stress.	
<b>Help Received</b>  I prepared the salinity solutions at school under my science teacher, Mr. Nguyen's supervision. Dr. Kanika Sharma Mitra was there to answer my questions when I had confusions.	