



# CALIFORNIA SCIENCE & ENGINEERING FAIR 2019 PROJECT SUMMARY

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<b>Project Title</b>  <b>Effect of Temperature on Embryonic to Larval Development of Sand Dollars, <i>Dendraster excentricus</i></b>	
<p style="text-align: center;"><b>Abstract</b></p> <p><b>Objectives</b> Understanding how life responds to changes in temperature is a critical endeavor given the predicted climate changes the planet will experience in the future. The aim of this study was to investigate the effects of temperature on embryonic and larval development rate and larval morphometrics of sand dollars, <i>Dendraster excentricus</i>. It was hypothesized that <i>D. excentricus</i> cultured at 21.5°C would develop faster with greater average post oral arm length (POAL) and POAL to mid body length (MBL) ratio than those reared at 13.5°C.</p> <p><b>Methods</b> Embryos were grown at 13.5°C and 21.5°C seawater and were monitored every thirty minutes for development using the microscope. Microphotographs of the larvae were taken and analyzed for their morphometrics( post oral arm length (POAL), mid body length (MBL), and stomach length) every two-three days using the software Image J.</p> <p><b>Results</b> Embryonic cell division rate was significantly higher at 21.5°C than 13.5°C (ANCOVA Temp*time p&lt;0.05, p=0.008). Larval developmental rate was also significantly faster at 21.5°C, p=0.012. The difference in MBL and the stomach length between the larvae in 13.5°C and 21.5°C increased with time. POAL was longer in high temperature larvae early in development, resulting in a large difference in the POAL: MBL ratio. This difference diminished as larval development progressed.</p> <p><b>Conclusions</b> The hypothesis was partially supported because while the developmental rate of <i>D. excentricus</i> in 21.5°C was greater than the developmental rate of those in 13.5°C, the POAL and the POAL:MBL ratio was only significantly greater in 21.5°C early in development. These results are important because with increasing global temperatures, larvae will increase their metabolic rates and abating physical adaptations to this in later stages could adversely impact the survival of these species. These results confirm the necessity for integrative approaches for understanding the true effects of temperature changes on organismal biology.</p>	
<b>Summary Statement</b>  This project investigated the effect of temperature on embryonic and larval development rate and larval morphometrics of sand dollars, <i>Dendraster excentricus</i> .	
<b>Help Received</b>  Cabrillo Marine Aquarium provided the facility and materials used in this project. Dr. Douglas Pace from Cal State Long Beach and Dr. Andres Carrillo, Janine Rodriguez, and other staff from the Cabrillo Marine Aquarium reviewed my research plan and paper and were consulted for any questions and suggestions.	