



**CALIFORNIA STATE SCIENCE FAIR  
2012 PROJECT SUMMARY**

|   |                                       |
|---|---------------------------------------|
| <b>Name(s)</b><br><b>Rose L. Leopold</b>  | <b>Project Number</b><br><b>S0804</b> |
| <b>Project Title</b><br><b>Morphological Disparity during the Ammonoid Recovery after the Permian Mass Extinction</b>   |                                       |
| <b>Abstract</b><br><b>Objectives/Goals</b><br>The Permian mass extinction caused the elimination of 80% of marine genera. Ammonoids, however, survived the extinction and returned to the levels of diversity that had been seen in the Late Permian within a million years while other groups recovered at a much slower rate.<br><br>This project examines how morphological disparity in ammonoid fossils decouples from taxonomic diversity following the Permian mass extinction. I hypothesized that the two diversities would follow the same trends before the extinction, but then break away from each other before once again leveling out.<br><b>Methods/Materials</b><br>I measured whorl expansion, umbilical diameter, aperture height, aperture shape and ventral acuity from illustrated specimens of 135 genera and used principal components analysis to quantify morphological diversity.<br><b>Results</b><br>Ammonoid disparity decreased after the extinction, but did not reach its lowest until the Dienerian sub-stage (2 sub-stages after the extinction), unlike taxonomic diversity which was lowest immediately after the extinction. By the Smithian sub-stage (4 sub-stages after the extinction) ammonoids had recovered in both morphological disparity and taxonomic diversity.<br><b>Conclusions/Discussion</b><br>Morphological disparity of ammonoids decreased after the extinction, but did not reach its lowest point until the next sub-stage. After reaching its lowest level of diversity on the Dienerian, ammonoids recovered at an astounding rate and regained the levels of diversity that were seen before the extinction and then even more. Taxonomically, ammonoids reached their lowest levels of diversity directly after the extinction, but then recovered around the same time as morphological disparity.<br><br>This was most likely due to their ecology which allowed them to avoid the deepest waters where oxygen levels were low and due to their high metabolic rate which enabled them to better adapt to ocean acidification. The response of these ammonoids can help us to understand traits like motility that allowed ammonoids to come back successfully from the brink of extinction unlike so many benthic groups. |                                       |
| <b>Summary Statement</b><br>I studied how morphological disparity among ammonoid fossils decouples from taxonomic diversity in ammonoids after the Permian Mass Extinction.   |                                       |
| <b>Help Received</b><br>Professor Clapham at University of California Santa Cruz supervised project   |                                       |