



**CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY**

Name(s) Shannon K. Hextrum	Project Number S1208
Project Title Does the Universe Play Dice? The Question of Determinism vs. Indeterminism in the Examination of Aleatory Music	
<p style="text-align: center;">Abstract</p> <p>Objectives/Goals My goal was to deduce whether or not a selection of aleatory music really was random. I questioned if the composers, and perhaps the human mind, can truly operate on an indeterminate level.</p> <p>Methods/Materials I used two compilations of sheet music by John Cage: John Cage Piano Works 1935-48 and John Cage Prepared Piano Music - Volume 2 1940-47. After selecting 10 pieces within these books, I counted the distribution of notes in each. I used these figures to tell how close the occurrences of each note were to yielding 1/12 of the whole. If each note appeared 1/12 of the time, I would assume that the pieces weren't biased in note selection and, thus, were random.</p> <p>Results The chi-square test for goodness of fit proved there was a 0% chance that my results followed the 1/12 ratios.</p> <p>Conclusions/Discussion The aleatory (or indeterminate) music was, in fact, caused (or determinate) because it held biases in notes. This could mean that the human mind cannot operate randomly, determinism may be quite applicable to our lives, or Einstein was correct when he stated, "God does not play dice."</p>	
Summary Statement My project uses music as a model to test whether determinism or indeterminism can be applied to events in our world.	
Help Received My math teacher, Peter Foster, showed me how to perform the chi-square test for goodness of fit. My piano teacher, Jean Alexis Smith, gave me resources concerning music history.	