



**CALIFORNIA STATE SCIENCE FAIR
2005 PROJECT SUMMARY**

Name(s) Anika C. Kuesters Smith	Project Number J0319
Project Title Screech! What Makes Particular Sounds Irritating?	
Objectives/Goals My project was about irritating noises. I wanted to see what combinations of two tones were perceived as irritating by a human subject. My hypothesis was that high pitched combinations and a pair of tones close to each other in frequency would be most irritating.	
Abstract Methods/Materials I obtained consent for testing from 20 subjects, ages 9-58. I generated the sounds in a computer programming system called Mathematica. I did two sets of experiments. All experiments required listeners to evaluate the irritation level of the tones played. In the first experiment, one tone stayed at 1000 Hz, the other started at an octave below, and in increments of 1/3 chromatic steps, went to an octave above the stationary tone. The subjects rated the sounds on a scale of 1-10. In the second set (four experiments), subjects rated the sounds by comparing one tone pair to another. The first of these experiments was to verify whether what I had found in the first set (the steady upward trend) was true, by presenting a set of sounds ranging over 5 octaves, but in random order. The other three experiments were more detailed studies about listener responses to closely-spaced tones.	
Results Subjects found higher pitched noises more irritating. In terms of tone combinations, subjects found tones close in frequency pleasant with the level of irritation growing until the tones were separated by about two chromatic steps. For tone pairs occurring at harmonically related intervals, the minor third, fifth, and unison points stood out. The fifth was pleasant. The minor third was pleasant, which is interesting considering that the major third didn't stand out. The unison was, unexpectedly, relatively unpleasant. See below, in Discussions.	
Conclusions/Discussion My hypothesis proved to be partially correct in that the high pitched sounds were the most irritating. But, contrary to what I had expected, combinations of tones that were very close to each other in frequency turned out to be pleasant. The evaluation of certain harmonic intervals as irritating or pleasant sounds was not included in my hypothesis; I added it on later. It turned out that the fifth, minor third and octave were all pleasant. I feel my results answered my question well. This project only focuses on a small aspect of irritating noises, but it is a start to answering a broader question, What makes a noise irritating?	
Summary Statement How irritating are particular combinations of tones?	
Help Received My dad/advisor helped define the experiment, assisted me in setting up the sound producing hardware and showed me how to produce the sound pairs using Mathematica.	