# CALIFORNIA STATE SCIENCE FAIR
## 2003 PROJECT SUMMARY

**Name(s)**
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**Project Number**
**J1522**

**Project Title**
## Will Temperature Change the Frequency?

**Abstract**

**Objectives/Goals**
I play orchestra bells in my Junior High School band. One day, my band director was checking instruments with his tuner. I was surprised to find that my bells registered a lower pitch than they should have. Because of this experience, I decided to investigate how thermal expansion in metal pipes affect the frequency at which they vibrate when struck. Research states that at different temperatures the pipes will expand or contract, changing the initial length. Due to this length change, the frequency of their vibrations should change as well.

**Methods/Materials**
Ten pipes each of aluminum, stainless steel and black steel were cut to the same length. Sound wave recordings were made of five pipes of each metal at room temperature (21C) to be used as the control set. Next, the remaining five pipes of each metal were struck at different temperatures -- hot (46C in a oversized packing box heated by standard light bulbs), room temp (21C free standing in family room), and cold (-15C by placing them in an empty chest freezer); and their sound waves were recorded on sound editing software. The recordings were then converted into Fourier transforms where the frequency of each recording could be read. In order to analyze the data, part of this project required that I learn about Fourier transforms and become familiar with the computer software required to determine the frequencies.

**Results**
Results show that thermal expansion did take place. The pipes that were heated had a lower frequency than the room temperature ones because they expanded. The cold pipes had a higher frequency because they contracted. Also, the aluminum pipes proved to have the most regular frequencies. On the other hand, the black steel was the most random of the three types. Instead of a nice spike in the Fourier transform to clearly define the frequency, these recordings had three or four tall peaks.

**Conclusions/Discussion**
This project was definitely successful. The pipes did undergo thermal expansion and changed frequencies. If this project were repeated, an explanation as to why the black steel frequencies were so irregular would be desired.

**Summary Statement**
My project examines how thermal expansion in a metal pipe has an effect on its fundamental frequency.

**Help Received**
Father helped with cuttting of metal pipes and assisted in manning computer station while I struck pipes.