



**CALIFORNIA SCIENCE & ENGINEERING FAIR
2018 PROJECT SUMMARY**

Name(s) Heidi C. Bishop	Project Number J2105
Project Title Cool Tunes: The Effect of Temperature on Instrument Tuning	
<p style="text-align: center;">Abstract</p> <p>Objectives/Goals My objective was to discover if temperature affects instrument tuning.</p> <p>Methods/Materials The saxophone, bugle, orchestra bells, and flute were tuned using a tuner and the "warmed up" temperature of the instruments was determined. Each instrument was refrigerated for 60 minutes. The instrument was removed, its temperature measured, and it was played to determine if it was flat, sharp, or in tune. The instrument was then set down for another 10 minutes and its temperature measured and tonality checked. This repeated every 10 minutes until the instrument was in tune. Three trials of the experiment were done per instrument.</p> <p>Results Saxophone temperature ranged from 2.2°C to 25.1°C and tonality ranged from -45 flat to +10 sharp for G. Bugle temperature ranged from -0.3°C to 28.3°C and tonality ranged from -40 flat to 0 in tune for D. Orchestra bells temperature ranged from 0.1°C to 23.5°C and tonality ranged from -40 flat to +20 sharp for B flat. Flute temperature ranged from 2°C to 31.5°C and tonality ranged from -60 flat to 0 in tune for B flat.</p> <p>Conclusions/Discussion My hypothesis was that an instrument at colder temperature would be more out of tune than after it had been warmed up. Data showed all instruments were out of tune after being refrigerated for 60 minutes. This proved my hypothesis correct. The flute appeared to be the most affected by the temperature change followed by the saxophone and bugle. The orchestra bells were a little more sporadic with their pitch. In conclusion, temperature definitely affects the intonation of instruments. For eleven trials, instruments were all flat at colder temperature. For one trial with the orchestra bells the instrument was sharp. In all trials, instruments were not in tune for at least 20 minutes after being refrigerated.</p>	
Summary Statement My project showed that cold temperature negatively affects instrument tuning.	
Help Received My parents provided the supplies needed for me to do my project.	