CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)

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Project Number

J1806

Project Title

The Effects of Temperature on the Resonant Frequency of a Singing Wineglass

Abstract

Objectives/Goals

This experiment investigates the effect of temperature on the resonant frequency of a wineglass. As a wineglass at room temperature is filled with water, its resonant frequency decreases nonlinearly. If the wineglass is heated (or cooled), or if the water in the wineglass is heated (or cooled), the hypothesis is that the resonant frequencies will follow the same nonlinear pattern as the glass at room temperature, but will be comparatively higher (or lower). This hypothesis is based on the principle that molecules at higher temperatures oscillate more quickly, thus resulting in higher resonant frequency.

Methods/Materials

A wet finger was rubbed along the rim of a wineglass filled with water at varying levels to produce a tone. Using a SEIKO ST757 Chromatic Tuner, the pitch of this tone was detected, along with its offset in cents (1/100th of a musical half step). This value was converted to frequency in Hertz, mean averaged with four other trials, and recorded. The experiment was conducted under four temperature conditions: hot wineglass, hot water in the room temperature wineglass, cooled wineglass, and cold water in the room temperature wineglass.

Results

For each temperature condition, the curve did have a similar shape to the control. Only the cooled wineglass produced consistently lower resonant frequencies than the control. At every water level, the resonant frequency of the cooled wineglass was between 2 and 22 Hz lower than that of the glass at room temperature. The mean resonant frequencies produced by the heated glass, hot water, and cold water at each water level fluctuated both above and below the resonant frequency of the room temperature glass, on the order of less than 20 Hz, a difference barely perceptible to the human ear. No general trends could be detected for the resonant frequencies of the heated glass, the glass with hot water, and the glass with cold water.

Conclusions/Discussion

While the data did not contradict the hypothesis, it was inconclusive. In the condition of the cooled glass, the hypothesis was supported by the results: the resonant frequencies were lower at every water level. In the other conditions, however, the data was inconclusive, and did not clearly prove or disprove the hypothesis. In these cases, the molecules of the glass were not heated up or cooled down sufficiently to change the resonant frequency of the wineglass consistently.

Summary Statement

The experiment determines the effects of temperature on the resonant frequency of a wineglass.

Help Received

My mother helped me decipher the conversion from values in cents shown on the tuner to frequency in Hertz.