



**CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY**

Name(s) Michael T. Helmeste	Project Number S1510
Project Title The Effect of Wave Guide Geometry on Longitudinal Acoustic Waveforms	
Abstract Objectives/Goals PROBLEM STATEMENT: The purpose of this project is to determine whether or not the geometry of simple waveguides affects the sound waves put through it, and if so, in what manner. HYPOTHESIS: My hypothesis is that waveguides (size of 1" to 4" diameter) will have degradation of the higher frequencies, as well as a lower frequency resonance similar to that of sewer pipes. I do not think that bends in the waveguide will have any significant effect on the overall sound. Instead, I predict that such bends will have effects on specific bands of frequencies according to their placement in the waveguide. Methods/Materials MATERIALS: (list is abbreviated due to space constraints)(i)Alesis Monitor One Mk2 Studio Monitors and RA150 Reference Amplifier;(ii)Alesis Studio32 16 channel/4 main bus/6 aux bus Mixer;(iii)Alesis XT20 20 Bit/48kHz sample/8 track ADAT Digital Audio Recorder;(iv)Alesis AI3 24 Bit Analog Optical Interface; JLCoper DataSync2 ADAT to Midi Sync;(v) Pentium III desktop computer with SoundBlaster Live and Windows 2000 operating system;(vi) 3 each: 1.5" PVC, 2" PVC, 3" PVC, 4" PVC pipe sections;(vii) 45 degree, 90 degree pipe elbows, and straight thru connectors in 1.5", 2", 3", and 4" sizes; 180 degree "U" bend for 2" pipe and valve for 2" pipe; Various cables and converters, box, stands, microphone,etc.;(viii) Matlab Release 12 and Signal analysis toolbox for Matlab Release 12, SpecLab freeware spectrum analysis software, SoundForge audio manipulation software, Cubase SX software for audio sequencing and sync control. PROCEDURE: A. Pipe configurations were tested. B. Put the ADAT tape into the recorder, and record the test patterns. C. Set up the waveguide. D. Select record on an ADAT track and route the test signal (track #1) to the studio monitors. E. Record data. F. Analysis of data using Matlab and other software as needed. G. Repeat of procedure using new pipe configuration until all pipe configurations have been tested. Results RESULTS: As the waveguide got smaller, the high frequencies dropped off very quickly, and the low frequencies transmitted with high resonance. Conclusions/Discussion CONCLUSIONS: My hypothesis was proven to be correct. Much low frequency sewer pipe resonance was detected among even the best of the waveguides, and high frequencies had significantly greater	
Summary Statement The effect of wave guide geometry on longitudinal acoustic waveforms was studied.	
Help Received Mr. Malin, my physics teacher provided interesting ideas. Mr. Joe Jenkins, cellular radiophone engineer provided information and pictures of waveguides. My parents bought equipment for me.	