



**CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY**

Name(s) Marlis Gnrke	Project Number J1511
Project Title The Magic Flutes	
<p style="text-align: center;">Abstract</p> <p>Objectives/Goals My objective was to understand how the flute works as a musical instrument.</p> <p>Methods/Materials I constructed model flutes from plastic irrigation pipe. My flutes varied in length, bore diameter, and number, size and location of finger holes. To play the flutes, I sealed one pipe end with my hand, and blew over the mouth hole near the closed end. I determined the pitch by comparison to known tones played on a piano.</p> <p>Results My experiments showed that the flute acoustically functions as a pipe open on both ends. I also found that long flutes with a small bore diameter perform more according to theoretical expectations than short flutes with a large bore diameter. Addition of finger holes raised the pitch by shortening the effective pipe length. Bigger holes raised the pitch more than smaller ones, while alignment of finger holes did not have an effect on pitch. By using cross-fingering, I was able to play almost a complete scale on a flute with evenly spaced finger holes.</p> <p>Conclusions/Discussion The results supported my hypothesis that reducing the flute length or adding finger holes raises the pitch of a flute. However, multiple finger holes had an unexpectedly complex effect on pitch. I also was surprised to find that the flute functions as a pipe open on both ends, although one pipe end is closed.</p>	
Summary Statement Using simple model flutes, I determined the effect of length, bore diameter, and number, size, and location of fingerholes on the pitch of this wind instrument.	
Help Received Dad helped construct flutes; Music teacher and mom helped understand acoustics; Mom helped present results	