



**CALIFORNIA STATE SCIENCE FAIR  
2004 PROJECT SUMMARY**

<b>Name(s)</b> <b>Frederick J. Meyer</b>	<b>Project Number</b> <b>J0718</b>
<b>Project Title</b> <b>An Analysis of Active vs. Passive Electronic Filters</b>	
<p style="text-align: center;"><b>Abstract</b></p> <p><b>Objectives/Goals</b> The goal of this science project was to understand the properties of active filters. I studied the basic theory behind operational amplifiers (op amps) and showed how they can be used along with capacitors and resistors to create any kind of filter in the audio frequency range. I designed many working active electronic filters and compared their performance to same-value passive electronic filters and simulated filter designs.</p> <p><b>Methods/Materials</b> After studying op amp theory, I began by designing simple op amp circuits like integrators and voltage followers to understand the advantages of high input impedance. I also experimented with negative feedback to understand how it can change the shape of filter plots. I designed active filters and tested their properties and compared them to their passive versions. Using Microcap circuit simulation software I compared my actual bode plots with the simulated plots. I designed and built low pass, high pass, band pass and band stop filters. Finally, I tested a very high quality Klipsch passive crossover filter and compared it's bode plot to a Microcap simulation of the circuit and then designed and built an active filter version of this device ending with a 6th order active crossover. My test bench was a PC with a sound card and shareware spectrum analyzer/oscilloscope software, woofer and tweeter speakers, and an audio amplifier.</p> <p><b>Results</b> Active filters allowed much finer control of the filter shape and Q, did not have losses and were, in some ways, easier to design than passive filters. They were easily modified and had greater linearity.</p> <p><b>Conclusions/Discussion</b> This experiment showed how active filters can duplicate much of the functionality of passive filters at lower cost, higher performance, greater flexibility and smaller size. The high input impedance and low output impedance made higher order filter designs straightforward.</p>	
<b>Summary Statement</b> The goal of this science project is to understand the properties of active filters and to use the data gathered to design working active electronic filters and compare their performance to passive electronic filters.	
<b>Help Received</b> My Mom did the spray glue for my display board. My Dad drove me around to buy electronic components, and to the UCSC library for research. I designed and drew all my own circuits, built all my filters and did all tests.	