



**CALIFORNIA STATE SCIENCE FAIR
2002 PROJECT SUMMARY**

Name(s) Catherine L. Chu	Project Number 22686
Project Title The Synergistic Effect of Hydrogen Peroxide and Ultraviolet Irradiation in Killing Escherichia coli	
Objectives/Goals The purpose of this project was to evaluate the synergistic effect of hydrogen peroxide at different concentrations and ultraviolet irradiation at different intensities in killing Escherichia coli. Abstract Methods/Materials Escherichia coli was cultured in Luria Broth until the bacteria concentration was 10^8 cells/mL. The E. coli was resuspended in distilled water. For the first experiment, nine mL of E. coli was put into an empty petry dish. One mL of hydrogen peroxide (0.01%, 0.1%, 1%, 2%, 3%) was added to the E. coli. The solution was swirled by hand for three seconds. 0.1 mL of the solution was taken by a pipet and placed onto a petry dish to be plated. For every concentration, five serial dilutions were made to ensure a platable number of bacteria. In experiment two, instead of putting one mL of hydrogen peroxide, one mL of water was placed into the bacteria. The ultraviolet lamp was held 10 cm, 20 cm, and 40 cm above the E. coli for three seconds. The plating procedures were the same as experiment one. The third experiment included using hydrogen peroxide and ultraviolet light together (e.g. 0.01% H ₂ O ₂ with 10 cm of UV at 254 nm). The petry dishes were put into an incubator for 24 hours at 37 degrees C. The bacteria colonies were then counted. Results Short wave ultraviolet light killed over 99.9% of all the bacteria within three seconds at 10 cm and 20 cm. When hydrogen peroxide was added, the hydrogen peroxide hindered the killing ability of short wave ultraviolet light alone. Long wave ultraviolet light killed only 10-15% of all the bacteria in three seconds when the lamp was 10 cm away from the E. coli. When hydrogen peroxide was added, it helped UV long wave kill E. coli. Conclusions/Discussion There was not a synergistic effect with UV short wave, but there was one with UV long wave. UV short wave was a very effective bacteria killer by itself. Hydrogen peroxide could have hindered the killing effect of UV shortwave because at certain concentrations, H ₂ O ₂ can absorb the UV light. An explanation for the synergistic effect found with UV longwave was the hydrogen peroxide first released hydroxyl radicals that attached to the cell membrane. The ionized cell membrane is denatured; thus, the UV light can easily enter the cell's nucleus, form covalent bonds between the nitrogenous bases in the DNA, and kill the bacteria.	
Summary Statement A synergistic effect was found between ultraviolet long wave and hydrogen peroxide, while a synergistic effect was not found between ultraviolet short wave length and hydrogen peroxide.	
Help Received Lab equipment at the University of Southern California under the supervision of Dr. Casey Chen.	