CALIFORNIA STATE SCIENCE FAIR
2002 PROJECT SUMMARY

Name(s)
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Project Number
S0211

Project Title
Response of Smoke Detectors to Different Types of Fire Conditions

Abstract

Objectives/Goals
Smoke detectors are effective in saving thousands of lives every year from fires in residential homes. Two technologies of smoke detectors, ionization and photoelectric, are widely available. Because these two detectors have different designs, their reaction times vary depending on the nature and amount of smoke present. Understanding reaction time properties to common smoke conditions that might arise in residences provides valuable information to guide the appropriate location of detectors. The objective of this experiment is to compare the reaction times of an ionization detector to a photoelectric detector under a variety of fire conditions.

Methods/Materials
An ionization detector and a photoelectric detector were tested under wood smoke, cooking smoke, and cloth smoke conditions. A paired design, in which both detectors, attached to a wooden rod, were exposed simultaneously to a series of fires, was used to control variables such as the amount of smoke and distance of the smoke detectors from the fire source. For each fire, the detector response times were measured with two electric timers. Thirty-five replicates of the experiment were performed for the three types of fires. Mean response times were compared using graphs and the paired t-test.

Results
The ionization detector had a lower mean response time to both the wood and the cooking smoke, and both tests yielded statistically significant results. The photoelectric detector had a lower mean response time to the cloth smoke, but the results were not definitive enough to be statistically significant.

Conclusions/Discussion
The location of detectors and minimization of false alarms are both important considerations for their effective use. The results suggest the use of an ionization detector in places subject to flaming fires, such as a living room. Alternatively, a photoelectric detector may be preferable in basements, or other places where smoldering fires might occur. Dual detectors, which use both ionization and photoelectric technologies simultaneously, are optimal.

Summary Statement
This project compared the mean response times of ionization and photoelectric smoke detectors under three different fire conditions.

Help Received
Father helped operate the timers.