CALIFORNIA STATE SCIENCE FAIR
2015 PROJECT SUMMARY

Name(s)

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Project Number

J0303

Project Title

The Chinchiller: For the Coolest Pet on the Block: The Effect of Air Flow Restriction on Evaporative Cooling

Abstract

Objectives/Goals

During a major heat wave last September in Los Angeles, my pet chinchilla died from heat stroke. My objective was to create a evaporation-based cooling device for pet chinchillas and determine the optimum air flow rate to produce the greatest amount of cooling. I believed that too much or too little warm airflow would not produce the best cooling effect.

Methods/Materials

I designed and built a cooled resting block called the "Chinchiller" that goes inside the chinchilla's cage. The glass block is chilled by pumping water through it that has been cooled by evaporation. Evaporation rate is adjusted by varying the amount of air flow that blows across a wet cloth that has water pumping over it. I adjusted the airflow using different sizes of holes in disks that were placed in front of a fan. Using thermocouples and a computerized data acquisition program, I was able to record the temperature of the water. For each disk hole size and over the course of several days, the fan was alternately turned on and off at least 5 times to determine the effect of evaporation.

Results

I recorded the temperatures of the water exiting the evaporator (my dependent variable) for different disk hole sizes (my independent variable) compared to the temperature without the fan running (my control). I varied my disk hole sizes from 7.62 cm, to 5.40 cm, to 4.13 cm, and 2.86 cm. The air flow through the smallest-hole size disk (2.86 cm) cooled the temperature down an average of 2.3°C, which was the same amount the pump warmed the water due to friction. The 4.13 cm disk brought down the temperature by an average of 3.9°C. The disk with the larger hole, 5.40 cm hole and the 7.62 cm hole, both brought the temperature down by about the same 4.6°C.

Conclusions/Discussion

The airflow through 5.40 cm hole and the 7.62 cm hole was successful in cooling the block below room temperature, overcoming the warming effect of the pump by several degrees. My prediction was partially correct; the evaporative airflow through medium-sized hole cooled down the water better than the smaller holes, but was the same as the larger hole, so restricting the airflow does not actually help. My results showed that air flow beyond a certain rate did not result in any additional cooling effect.

Summary Statement

I created a Chinchiller device that will keep a pet cool on hot days that works bencause of evaporative cooling.

Help Received

I received help from my dad, who helped me design the Chinchiller, supervised me when I was using power tools, helped me install and use the Dataq data acquisition software, and taught me how to use Excel to make the tables and graphs.