Solar House Project Summary

Introduction

Imagine that a new energy-efficient housing development is looking for a project engineer. The project engineer will be responsible for all design and construction decisions related to heating and cooling energy use. The project involves a variety of house designs that all need to be energy efficient.

This final report will be used to persuade a review committee that you have the understanding and inventiveness to apply what you have learned to the entire housing project.

Your project was a preliminary study to identify the most important features of an energy-efficient house. The committee will be looking at the energy performance of your model house as one indication of your skill. It will also look at the design ideas and materials you used to accomplish this. Equally important, however, you must demonstrate that you understand the science behind the energy-efficient designs and would be able to make further improvements and develop other designs.

Complete all of the sections below.

Here is the outline of your report:

House performance: experimental data

Explanation of house performance and design choices

Heat flow analysis

Conclusion

Note: This is one chapter of a longer engineering project which includes modifying and retesting this house as well as explorations of the various mechanisms of heat transfer—conduction, convection, radiation, and heat capacity—with hands-on or model-based experiments. See: http://concord.org/engineering

Energy-Efficient House Project: Final Report

Name:

House dimensions

Floor area (cm^2):

Total window area (cm^2):

Total surface area (cm^2):

HOUSE PERFORMANCE: EXPERIMENTAL DATA

Gather the results of your experimental data in the table below.

Summary of experimental data		
Winter heating	Power requirement (W)	Percentage of power requirement compared to the standard house*
Standard house, no sun condition		= 100%
Standard house, winter sun condition		
Own house, no sun condition		
Own house, winter sun condition		
Own house, with all modifications, no sun condition		
Own house, with all modifications, winter sun condition		

* For example, if the standard house requires 20 W and "own house, no sun condition" requires 15 W, the percentage is 15/20 = 75%.

EXPLANATION OF HOUSE PERFORMANCE AND DESIGN CHOICES

House design

Describe the major features of your design (for example, the shape of the house, placement of windows, material choices). In each case, describe the feature, how it functions, and your evidence that it works that way. Use scientific explanations from the Heat Transfer unit to explain how each of these features affects energy efficiency. Refer to your experimental data to support your claims.

Modifications

What did you learn from your experiments that guided your design choices? Explain what features were added after initial experiments, what features were modified, and how they affected the energy performance of the house. Include evidence from your experiments.

HEAT FLOW ANALYSIS

Draw a picture of your house in vertical cross section, which is a slice through the center in the North-South direction. Label the wall, window, and roof materials. Label North and South.

Describe where and how heat is lost from your house and how different modifications changed the rate of heat loss. Use evidence from the Heat Transfer Basic units to describe the process.

On your drawing show your best guess for the temperature distribution throughout the house. Write down what you think are likely values of temperatures in various locations, assuming the outside temperature is 5 °C, the heater temperature is 40 °C, and the average temperature in the house is about 25 °C.

Draw arrows to show how you think heat flows around inside your house as well as in and out of your house.

CONCLUSION

Given what you know now, if you were starting again from scratch and could make a completely different design, what materials and design features would you choose for your house? Why?