Heat Transfer

Energy Detective

Introduction

As a wrap-up, use the model to explore heat flow in a whole house model. You can move temperature sensors around, just as you would with real temperature sensors in the standard house model. The advantage of a computer model is that you can change features and make measurements very quickly. And you can also add as many sensors as you want. On the other hand, a model is never just like the real world.

6A: A well-insulated house vs. a poorly insulated house

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Use the model to investigate the quality of construction of the two houses. Open Model 6A and follow the instructions. Then answer the following questions.

Which house required more power to keep warm, A or B? Explain how you figured this out.

Go back to the model and do more tests to answer these two questions. Recall that the rate of heat loss is proportional to the difference between inside and outside temperatures.

1. How much more power, roughly, does the less energy-efficient house require (for example, 1 ½ times, 2 times, 3 times, 4 times as much power)?

2. What is the ratio of high heater power to low heater power?

Note: This is one section of the "Science of Heat Transfer" chapter of the Engineering Energy Efficiency Project. See: http://concord.org/engineering

To download Energy2D software, go to http://energy.concord.org/energy2d/

To run the models in this chapter, go to http://energy.concord.org/htb

Note the video tutorial.

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6B: Where does this house lose heat the most?

Use the model to investigate the quality of construction of different parts of the model house. Open Model 6B and follow the instructions. Then answer the following questions.

Describe the method and measurements you used to find the poorly insulated places.

Fill out the following table with results from Model 6B.

Results from Model 6B		
Building section	Insulating quality (great, good, fair, poor)	Evidence (measurements)
A		
B		
C		
D		
W		
R		
G		

6C: Discover a vertical temperature gradient

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You have probably noticed that houses are often warmer near the ceiling than near the floor, and warmer upstairs than downstairs. This model shows the effect of natural convection in a house. Open Model 6C and follow the instructions. Then answer the following questions.

Results from Model 6C		
Thermometer	Temperature with ceiling	Temperature without ceiling
T1		
T2		
T3		

Describe the effect of removing the ceiling.

Many modern houses have living rooms in two-story spaces, so that the ceiling is 12 or more feet high. Explain why this kind of space is difficult to heat, and what you could do about it.

Summary

Think about a house you'd like to design. What directions and slopes (vertical, sloped, horizontal) would you choose for large windows? What directions and slopes would you choose for smaller windows? Why?