AREA AND HEAT TRANSFER

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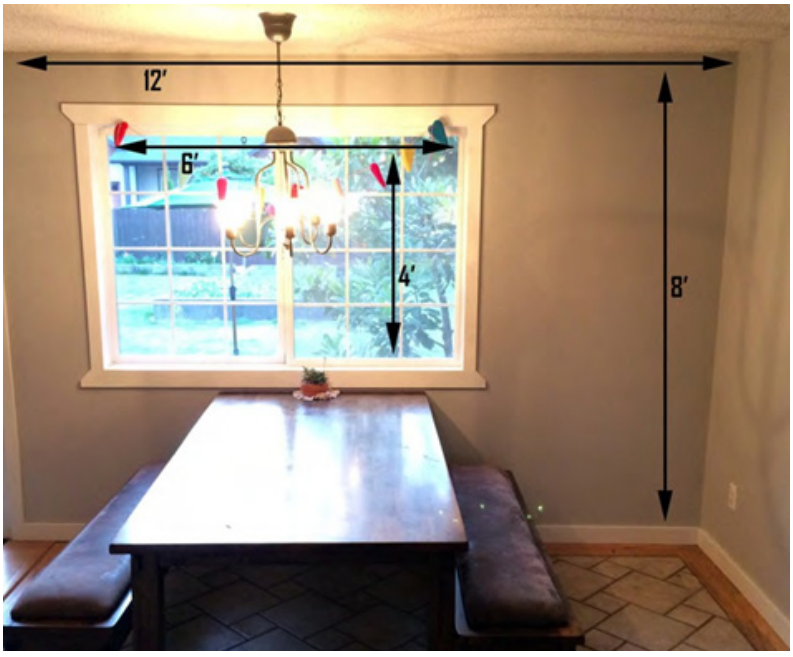
Using the graph paper provided, draw an exterior bird's eye view floor map of your house (or classroom) to scale. Be sure to include exterior doors and windows. You'll probably need a tape measure and a piece of scratch paper as you walk around the outside of your house to measure it.



Use the image to the left to answer the following questions about area and heat transfer. TIP: Use this symbol ⌑ to write "square foot" or "ft²" like a pro.

What is the total area of the wall? _____

What is the total area of the window? _____

What is the net area of the wall? _____

(total wall area) - (total window area) = (net wall)

Let's pretend it's 30 degrees outside. Brrrr... that's cold. It must be winter.
Our heating system is set to 70 degrees. That window has a U-factor of 0.48. That wall has R-11 of insulation.

(you'll use this information on the back of this page.)

Heat always wants to go from _____ to _____

We use a formula to determine the rate of heat transfer through a solid object from one space to another. In this case, we'll determine the rate that heat is being transferred through the dining room wall and window to the outside (pictured on the other page).

BTU/hour = U * A * AT

BTU

BTU stands for "British Thermal Unit" and is a common measurement of heat. It is said to be the amount of heat contained in one match, or the amount of heat needed to raise the temperature of one pound of water by one degree Fahrenheit. Heat energy is measured in BTU/hour, just like electrical energy is measured in kilowatt-hours (kWh).

U

A material's "U-Factor" is the rate at which heat (BTU/hour) transfers through 1 ft2 of material. The "U" stands for *übertragen*, which is German for "transfer". Windows have a "U-Factor". Insulation is measured in "R-Value". The "R" stands for resistance, and is the inverse of the "U-Factor" (U=1/R). To convert R-Value to U-Factor, divide 1/R. Circle the scenario below in which the heat moves faster:

R-0 or R-38 U 0.23 or U1.3? R-22 or U 0.39?

A

The "A" stands for area. Figure out the area for each space that you want to do the calculation. For our problem, use the values that you determined for the window and wall on the opposite side of the page. Remember, a wall and window have different rates of heat transfer (U-Factor and R-Value).

AT=

This triangle "fl" is read as "delta", which means difference. "flT" is a fancy way of saying, "What is the difference in temperature?" This is a major factor in determining how fast heat energy is transferred. The greater the temperature difference, the faster the heat transfers. Circle the scenario in which the heat moves faster:

70 degrees inside, 20 degrees outside ***OR*** 70 degrees inside, 50 degrees outside?

1. What is the U-Factor of the window? _____
2. What is the R-Value of the wall? _____
3. Convert the wall's R-Value to U-Factor: _____
4. What is the area of the window? _____ ⌀
5. What is the area of the wall (not counting the window)? _____ ⌀
6. What is the difference in indoor and outdoor air temperatures? _____ °F
7. Multiply U*A*(flT) for the Window: _____ BTU/hour
8. Multiply U*A*(flT) for the Wall: _____ BTU/hour

BONUS QUESTION:

Let's pretend this is a magical room and that heat is only lost through this one wall...

How many BTU/hour do you need to put into the space to maintain the same 70 degree temperature? _____ BTU/hour

List other areas in you home where you think heat could be lost (in the winter) or gained (in the summer).