Heat Loss Project: Designing an Energy-Efficient House

Objective:
Students will design, build, and test a model house to minimize heat loss, exploring how materials and colors impact insulation and energy efficiency.

This meets standard HS-PSP-2.1 Students who demonstrate understanding can: Create a computational model to calculate the change in the energy of one component in a system when the change in energy of the other component(s) and energy flows in and out of the system are known.

Video for set-up.

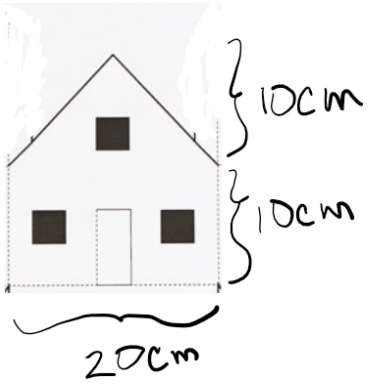
Video for calculating slope of heat loss

Materials:

- Balsawood (for the house frame)
- Paper or cardstock (for walls and roof)
- Thermometer or temperature sensor
- Heat source (e.g., lamp with a 100W bulb or small heater)
- Timer or stopwatch
- Insulating materials (e.g., aluminum foil, cotton, foam, felt, bubble wrap)
- Various colored paper or paint
- Tape, glue, or hot glue gun
- Ruler, scissors, and utility knife
- Data recording sheet

Procedure:

1. **Introduction and Brainstorming:**
    - What factors will affect the energy efficiency of a house?
2. **House Construction:**
    - Use balsawood for the frame of the house and paper/cardstock for the walls and roof.
    - Each group builds a house with the same dimensions to ensure consistent testing conditions. Here is a template for the front and back:



Make the sides 20 cm by 10 cm.
The roof pieces will be 15 cm x 22 cm.

3. **Testing Baseline Heat Loss of a house with no insulation or modifications:**
    - Place the house under a heat source to simulate sunlight or heating.
    - Open Vizeey on your phone.
      Add one temperature probe.
    - Record the starting temperature inside the house.
    - Take pictures of the house using the infrared thermal imaging camera and locate areas that have the most heat loss.
      Save a picture.
    - Allow the house to heat for 10 minutes.
    - Remove the heat source and record the temperature drop inside the house. Take a screenshot of your data.
4. **Improving your home by adding Insulation or other modifications to the problem areas:**
    - Each group selects two possible methods to avoid heat loss.
    - Examples:
        - Adding bubble wrap or foam to walls.
        - Using aluminum foil to reflect heat.
        - Changing the color of the roof or walls to test radiant heat absorption.
    - Groups must justify their choices based on their understanding of heat transfer principles.
    - Modify the house with one modification at a time.
5. **Testing Modified House:**
    - Repeat the testing process with each modification on the insulated house.
    - Save screenshots of your FLIR data.
    - Take screenshots of your cooling data.
6. **Analysis and Discussion:**
    - Observe the data from other groups.
    - Compare the effectiveness of different materials and colors in reducing heat loss.
    - Discuss trade-offs (e.g., cost, weight, sustainability) in selecting materials.

- Relate findings to real-world building design and energy efficiency practices.

Assessment:

1. **Data Collection and Presentation:**
    - Create a powerpoint of your house design and results, explaining how the modifications reduced heat loss.
2. **Include answers to the following reflection Questions:**
    - What materials were most effective at reducing heat loss? Why?
    - How did color impact the house's ability to retain or reflect heat?
    - How can these findings be applied to real-world construction and energy conservation?