Energy House Challenge

Students learn about efficiency, conservation, and economic returns by using various materials to insulate a cardboard house and then test its efficiency.

NEED
National Energy Education Development Project

Constellation
An Exelon Company

Energy House Challenge Instructions

Challenge

Insulation is a material used to limit the movement of thermal energy or heat. Your challenge is to build a model home out of cardboard that 1) meets the required building code rules described below and 2) uses insulation to slow or stop the movement of thermal energy (heat) into and out of your home. Insulation is helpful for keeping the temperature comfortable or steady inside a home, despite the outside temperature changes.

Materials

- Mailing tape
- Transparency paper or plastic wrap
- Aluminum foil - 1 yd
- Poster board
- Bubble wrap
- Cotton batting
- Padded paper
- Caulking
- Weather stripping
- Cardboard boxes
- Digital thermometer
- Scissors
- Ruler
- Pencil
- Resealable plastic bag
- Ice cubes

Question

- What materials will most efficiently insulate your home from the outside air?

Building Code

- ✓ You must have 1 door, at least 12cm x 7cm.
- ✓ You must have 2 windows, each at least 5cm x 5cm.
- ✓ The ceiling must be at least 5 cm above the top of the door.
- ✓ Insulation on the floor and walls cannot exceed 1 cm in thickness.
- ✓ No insulation can be exposed. All insulation must be covered by a ceiling, wall, or floor (poster board).

✔Procedure

1. Assemble your boxes so it stands up, but do not apply tape yet, as you will need to be able to install insulation. You will seal your home as the last step before you test!
2. Draw two windows and one door on your home box. These can be located on any side or face of your house.
3. Carefully cut out the windows and the doors, leaving one side of the door attached on your box. The doors should remain open and unsealed. Windows will be covered with transparency paper or plastic wrap, and sealed closed.
4. Examine your home to determine its insulation needs. Look at the materials available and read the building code thoroughly. Decide which materials you want to use and the amount you will need of each.
5. Follow the Building Code on page 2 and place the desired insulation materials in your home. Use the mailing tape as the method to secure and affix your insulation and attach wall coverings.
6. Seal your home with tape on the "roof" and "basement" cracks or openings. You may make your roof flat or pitched, based on your desired architectural design.
7. If it is a cold day outside, allow your model home to stay inside. If it's a warmer day, take your home outdoors. Place it outside so it will receive direct light. Measure and record the temperature of the room you're working in, or the temperature outside (on a warm day). Record this as your starting temperature in the data collection section beside number 1.

8. Fill a resealable plastic bag with eight, similarly sized ice cubes. Make sure the bag is sealed, and place it flat on the floor of your home. Close the doors of your home. Allow your home to stay outside for 15 minutes. This ice will act as a "cooling unit" for your home, creating a temperature difference outside versus inside. This "cooling unit" will also help you demonstrate how well the insulation you designed does its job to hold the temperature inside. Warmer air will want to come inside and cooler air will want to escape - insulation acts like a security guard to stop this from happening. If your insulation does its job, your home will be cooler at the end of the test than the outside air when you started.
9. After fifteen minutes, take the temperature of your home by inserting the thermometer into the home through the top of the door. Wedge the door closed so the thermometer stays inside but the door is mostly closed. Turn the thermometer on and wait 30 seconds to allow the thermometer to adjust. Record this temperature on the data collection section beside number 2.
10. Calculate the total temperature change for your home. Record it in the data collection section beside number 3.
11. Record observations about the ice cubes after 15 minutes in your home. How much has melted? How much longer do you think the ice would take to melt completely? Why?

Data Collection

1. Room / outside temperature at start (°F): _____
2. Insulated home temperature after 15 minutes (°F): _____
3. Difference (Δ) in temperature (°F): Insulated home _____
4. Ice cube observations: _____

_____

Conclusion

- Analyze your home design and the insulating materials you used. How efficient was your insulated home at maintaining its temperature? What would you do differently if you could design your house again? Why is insulation beneficial?