SOLAR HOUSE
STUDENT LAB TEMPLATE

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Abstract

Your team of architects has been commissioned to build a solar house, containing both active and passive solar components. First you must design the house and build a model. The model will be tested to determine its ability to use solar energy well.

Objectives

Your house will be designed to stay cool during the summer. During the winter, your house will be designed to warm up during the day and retain its heat well during the night. Your house will be pleasant and attractive to live in.

Introduction

A solar house takes advantage of solar energy to minimize the use of traditional energy sources. This can include design elements that take advantage of the sun's rays to light and heat the house, to heat water, and to set up a favorable flow of air. Many solar houses contain a solar mass that will absorb the heat during the day and release it slowly at night. A passive solar house also takes into account the angle of the sun's rays, to maximize heating during the winter and shade during the summer. In addition to passive solar elements, solar cells (photovoltaic cells) may be used to actively absorb sunlight and transform it into electricity.

Building Plans

Before construction can begin, you must submit a proposal that includes a floor plan and side, front, and rear views, showing all windows, doors, etc. List and describe at least three innovations that make this a passive solar house. Show the location and describe how you will use the fan or any other device powered by solar panels. Only upon approval of this plan may construction begin.

Background Research Information Links

http://www.ncsc.ncsu.edu/solar_house/NCSU_solar_house_design.cfm

http://www.ruralhometech.com/altenergy/solarhouse.php

http://www.care2.com/channels/solutions/buildings/75

http://www.enme.umd.edu/solartech/design.html

http://www.healthgoods.com/Education/Healthy_Home_Information/Building_Design_and_Construction/reading_solar_ee_plans.htm

http://www.nesea.org/buildings/info/passivesolar.html

Specifications

- The house will contain 1,089 square feet of floor space. If you choose to make it square, this will be 33 feet by 33 feet. Your model will be built to a 33:1 scale, which means that the model will contain 1 square foot of floor space.
- The house must be designed to keep cool during the summer, to warm up well during the winter, and to retain heat well on winter nights.
- Innovations are welcome, but **must not present an unreasonable cost**.
- Porches, shutters, and awnings may extend beyond the specified area of the house.
- The house will contain no interior walls.
- Decorations to the *interior* of the house will **not** be considered in judging aesthetics.
- Aluminum foil or other materials that reflect light in a "mirror" fashion are not permissible on the exterior of the house as they are objectionable to neighbors (and a hazard to air craft).
- Doors must operate reasonably, i.e., without taking the wall off the house.
- Walls and roofs that are relocated between seasons or between day and night are too expensive to be reasonable and are not allowed. However, awnings, louvers, shades, curtains, and the like could reasonably be adjusted between seasons or between day and night.
- There must be at least two (working) doors of reasonable size (1 inch by 2.5 inches would be typical).

- There must be a minimum of 50 square inches of window area. People in the house must be able to have natural light during the day. It would be counterproductive to build a house so dark that residents would have to use electric lights during the day.
- The height of the house should be reasonable, since a house that is too large would be difficult to heat or cool. For example, rooms that are 33 feet high (1 foot on the model) would be unreasonable.
- The temperature probe that will be used to evaluate the performance of the house must be inserted in the center of the house and a few inches above the floor.
- While suitable landscaping is certainly important in the performance of a real house (and should be included in your lot diagram), in this project exterior landscaping is not allowed to interfere with the light hitting the house.
- Walls of your model *may be no more than 1 inch thick* (which would represent an actual wall of 33 inches).

Materials

Building materials may be chosen from the following (* indicates items supplied by instructors):

Walls may be constructed from:

- cardboard
- Styrofoam sheets*
- Foamboard

Flooring may be chosen from:

- cardboard
- Black or white linoleum*
- Black or white ceramic tile*

For windows you may use acetate plastic*.

For roofing you may choose among:

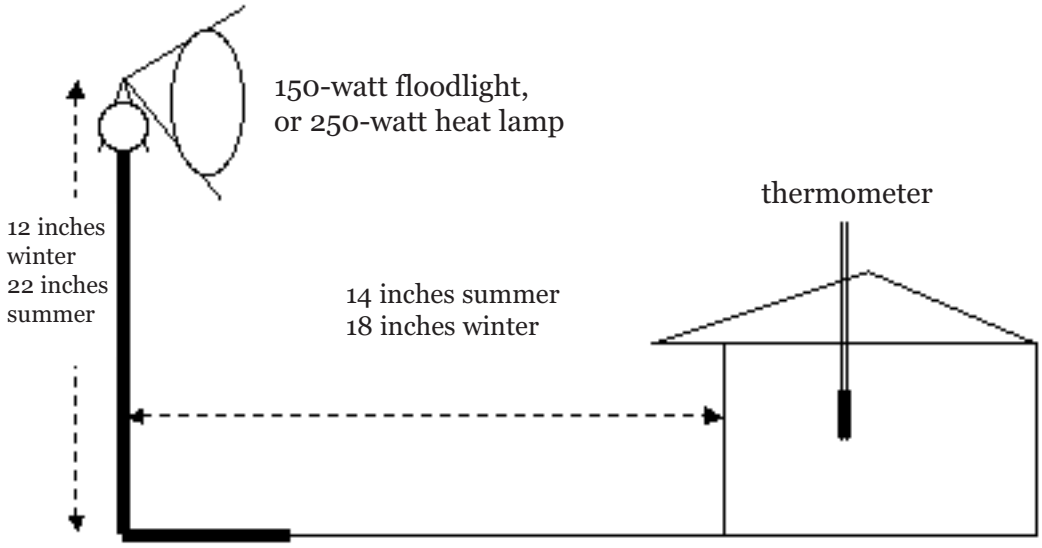
- White or black shingle*
- Any waterproof and practical material you wish to bring in yourself (cardboard, Styrofoam, duct tape, and foamboard are not by themselves considered waterproof.)

The parts of the house may be held together with duct tape*, glue*, toothpicks, or other tape. Paint or other decorative color is certainly permitted (and may be desirable) but will not be provided by the instructors.

You may use one or two solar panels* and the accompanying fan* and wiring*. You may include a water tank. Other building materials are certainly permitted but are not available from the instructors. These are subject to the building codes for your subdivision and need to be approved by your teacher in advance.

You are encouraged to scrounge materials, but **no member of your team may spend more than $5 on building materials for the model**.

Caulking of joints may be desirable, but materials for this are not available from the instructors.



Write-Up

Submit your final design and a typed report explaining the following:

1. Reasons for the design and choice of building materials -- 2 points
2. A plan of the house as seen from above for a small lot (about a half acre), compass directions, and major vegetation -- 2 points
3. The approved initial design -- 1 point
4. An analysis of how well each of the innovations worked -- 1 point
5. Suggestions for improvements -- 1 point

Grading

8 points: summer performance

Increase in temperature after 15-minute exposure to light, 14 inches from model at a height of 22 inches

8 points: winter performance

Change in initial temperature after being exposed to 15 minutes of light, 18 inches from model at a height of 12 inches, and then 15 minutes without light

2-3 points for every energy-saving innovation, up to a maximum of 12 points

5 points: aesthetic appeal (judged by suitable panel of instructors)

7 points: write-up

Best temperature data: change in winter temperature -- change in summer temperature

No write-up necessary: automatic 40 points