

Hot House

Student Instructions



Introduction

Imagine living in a house that doesn't require much gas or electricity to maintain its temperature. It is heated by the sun, keeps its heat, and is designed and constructed using materials that insulate—no solar panels required! In this challenge, you will use household materials to build a model passive solar house that heats up and retains its heat for as long as possible.

To be successful, your design must meet the following criteria:

- The house must heat up at least 20 degrees above the outdoor temperature after 20 minutes in the sunshine.
- The house must retain heat, with at least a 10-degree difference between the outdoor and house temperatures after 20 minutes in the shade.

Here are the engineering constraints for this challenge:

- The house must contain at least one door and one window that can be used to view the thermometer.
- The house must be at least six inches tall.
- The house must use at least two different types of insulation.

Brainstorm

Engineers and architects are using passive solar heating to rethink how houses are built. They are creating new designs that use materials that can absorb and retain heat from the sun, reducing the amount of gas and electricity needed

Materials

- [Heat It Up! temperature tracker](#)
- Ruler
- Thermometers (2—one measures the temperature inside your prototype; the other measures the outdoor temperature. The outdoor thermometer can be shared by all students in the group.)
- Timer

Variety of building materials that you have on hand, such as:

- Air pillows
- Aluminum foil
- Black fabric, paint, or paper
- Bubble wrap
- Cardboard boxes
- Clear plastic recyclable containers (that can be cut up to make windows and doors)
- Craft sticks
- Disposable cups (paper, plastic)
- Foam board
- Glue
- Markers
- Newspaper
- Paper (white, construction, cardstock)
- Quilt batting
- Scissors
- Stones
- Styrofoam
- Tape (duct, masking, packing)

to heat and cool buildings. Think about a greenhouse: sunlight passes through the transparent walls and roof, creating thermal energy, or energy that is made when something heats up. All objects in the greenhouse store thermal energy, including plants, soil, and the building materials themselves—the greenhouse floor, glass, concrete, and bricks. The thermal energy stored in the plants, soil, and building materials helps keep the greenhouse warm, even after the sun sets. The same ideas are used in passive solar heating.



Greenhouse at Nuffield Place by Steve Daniels, CC BY-SA 2.0

Your challenge is to design a model passive solar house that uses the sun's energy to heat the inside and insulative materials to retain that heat.

- 1 Take a look at your materials and consider how to build your house. You might ask yourself:
 - How big will my house be?
 - How will I construct it?
 - Which materials will heat up quickly or help retain heat?
 - What will the walls, window, door, and roof be made of?
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- 2 Sketch some designs or jot ideas.

Build, Test, Redesign

- 1 Build your passive solar house. Think about the greenhouse example. What could you put inside your house to help it retain its heat?
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- 2 Test as you build, and redesign as needed. You might need to take your house and thermometer outside, place the model in a sunny spot, and observe for five minutes to see how quickly it heats up. Then move it into the shade and see how well it retains heat. If your house isn't functioning the way you thought it would, try a different idea.
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- 3 When you're ready for the final test, follow the steps on page 1 and 2 of the *Heat It Up! temperature tracker*. Use the graph on page 3 to track the outdoor (shade) temperature and the temperature inside your house.
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- 4 Review the success criteria and consider whether you've met them. If not, make changes to your design and try again.

Reflect

- How effectively does your model passive solar house absorb and retain heat?
- What can someone learn about your house by examining your graph?
- What is working well? What do you think can be improved?
- What did you like and dislike about the challenge?
- What problems did you have when building, testing, and redesigning? How did you solve them?

Did your design meet the success criteria? Nice job! Share your results with a family member, teacher, or DiscoverE! You can also share photos and videos on social media and tag @DiscoverEorg.