To our teachers:

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Name: *_____

Date: *____ / ____ / ____ Class Hour: *____

Wisconsin Public Service
SolarWise for Schools
and the
Center for Renewable Energy
Advanced Technological Education

Building a Passive Solar Home

Student Lesson

Introduction:

The opportunity to “live off the grid” is the real attraction of renewable energy technologies for some people. Installing clean renewable energy resources that enable you to live independent of an energy utility can be very appealing. Of course, the advantages of “clean, green living” and energy independence must be weighed against at least three important considerations. You must:

- take responsibility for the operation and maintenance of your own energy generating system(s)
- adopt a lifestyle that is within your means to generate renewable energy
- consider the length of time it will take for you to see a return on your renewable energy investment.

These considerations are more easily managed if the energy-independent home has a low energy load profile. Every home has an energy load profile. It is the amount of energy used on average each day. It also takes into account peak energy requirements on a daily and seasonal basis. Reducing energy load requirements means that you can reduce the size of your renewable energy generating system(s).

Of course, shrinking or reducing a home’s energy load profile can be accomplished in part through good conservation measures. In an existing home, this can be done by adding insulation, sealing air leaks, replacing windows, replacing inefficient appliances, and so on. But perhaps the best way to reduce energy load profile is to build a new home to take advantage of its natural surroundings and manage or lessen the disadvantages. In this activity you will do both as you build your own passive solar home.

Materials:

- Design worksheets
- Scissors, tape, pipe cleaners, straight edge
- Protractor
- Light source (flashlight or lamp)
- Crayons or markers
- Teacher approved digital device for internet research

Procedure:

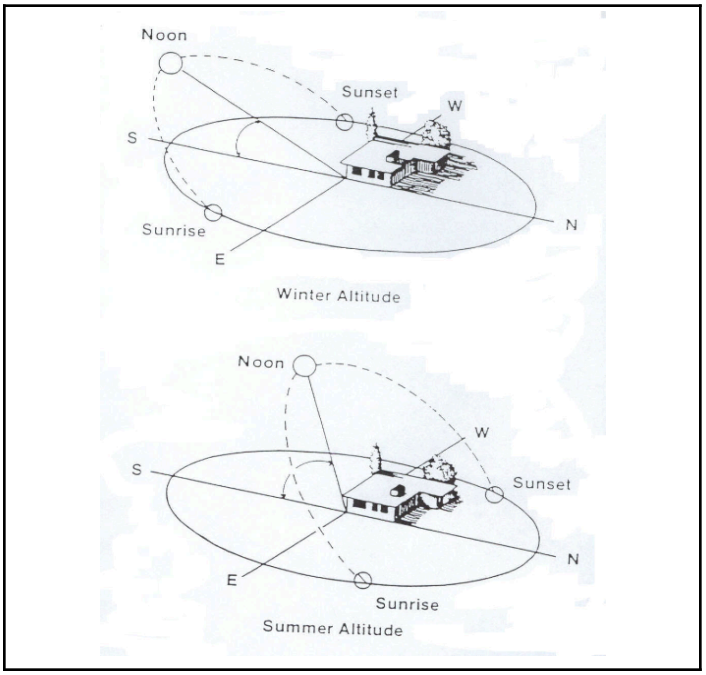
Every home collects solar energy. Sunlight falls on the house, some passing through windows and skylights where it is absorbed by roof and walls. Sunlight can help to heat a house in cold weather, but it can overheat the house in warm weather.

Some houses are specially designed with the sun in mind. The designer plans the home so that it collects as much sunshine as possible in the winter, and as little as possible in the summer (see **Illustration 1**, which follows). Such houses are called passive solar homes. They can save their owners a lot of expense in heating, air conditioning, and lighting.

Based on what you know about the sun and wind, you will assemble, locate, and landscape a model passive solar home. You'll be getting more information on these topics later, but to help you get started, consider these questions:

- What is the sun's path in the winter? In the summer?
- Where does most of the wind come from in the winter? In the summer?
- Where should most of my windows be?
- What kinds of trees and shrubs should I have around my house? Where should I place them?

Illustration 1. The sun's altitude in the sky, winter and summer. *(Illustration courtesy of the National Energy Foundation)*



1. Cut out both model house drawings from Worksheet A. Fold and assemble each house—without taping together.

2. Place the folded model houses on the plot plan (Worksheet B). Decide on the best place to locate or set a house on the plot plan. In which direction will it face? Decide how many windows and doors your house should have. Choose their locations based on the orientation (North, South, East, West) of the house.

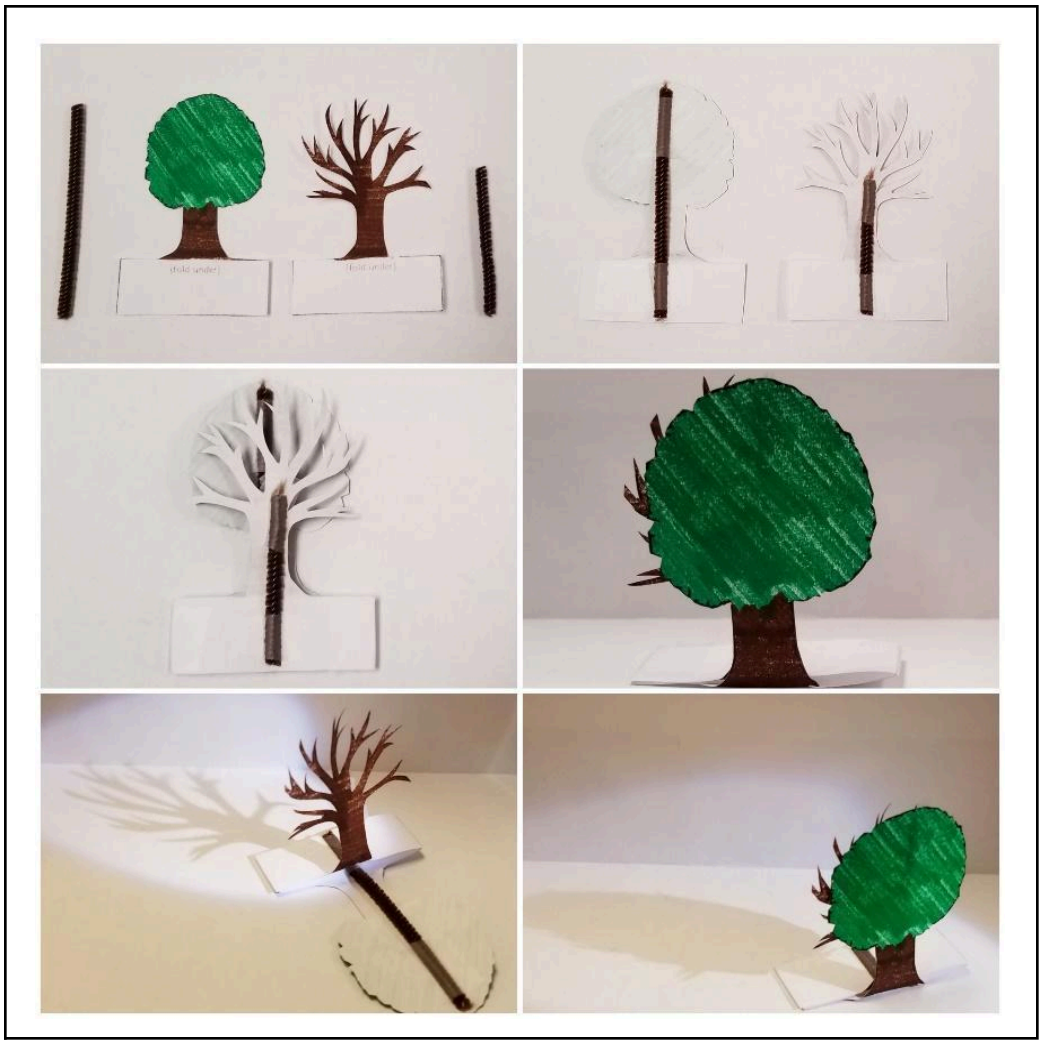
3. Decide which of the two houses will be the best to use. Unfold your selected model house and draw windows and doors neatly with a pencil and straight edge. Consider the material(s) from which your exterior will be made. Are there any other design features or technologies you might incorporate? Draw and color accordingly. Refold and tape the model together. Consider your roof, its technology, and color. Tape the roof in place. Place the completed house on the plot plan.

4. As you work through the activity, take the time to:
   - research answers to the questions brought up in this activity and questions that naturally occur to you, provided you stay within the time limits given to you by your teacher.
   - get or make additional or replacement copies of any of the worksheets. You may do this in an effort to improve your plot plan, landscaping, or house, provided you stay within the time limits given to you by your teacher.

5. Research the directions of the winter winds and summer breezes in your area. Draw arrows in the proper corners of your plot plan to indicate these directions. Label each arrow.

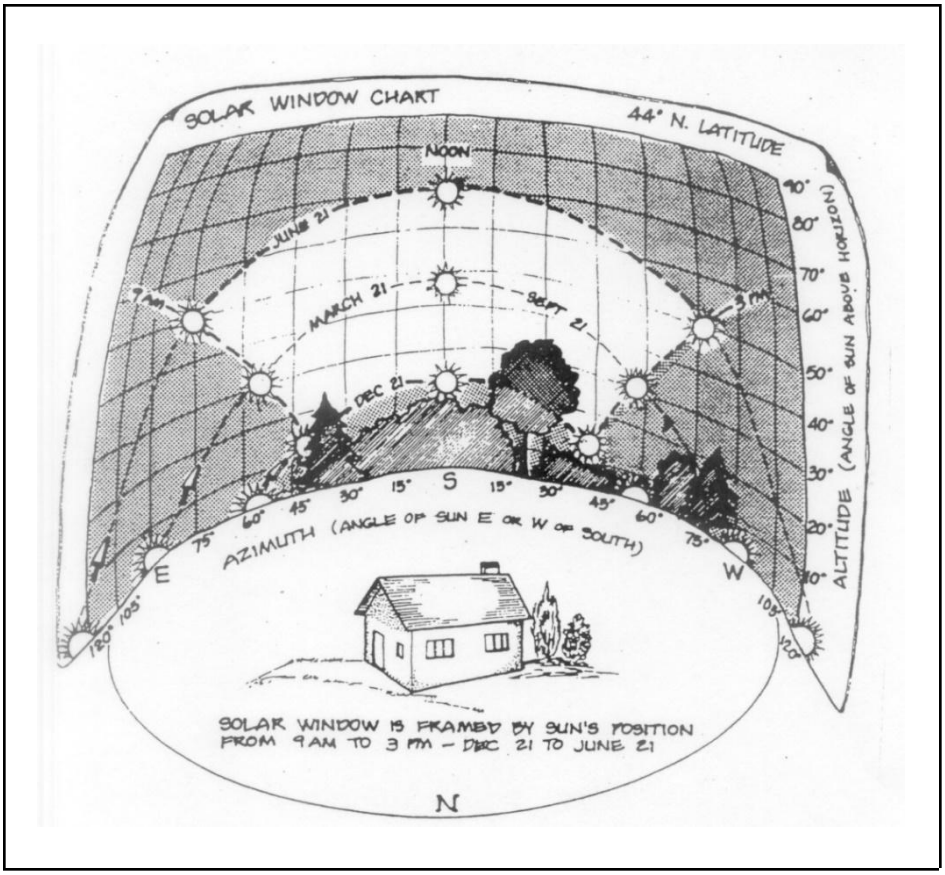
6. Draw in fencing (if any), driveway, and sidewalks. Can you place these features to provide protection from winter winds?

7. First color, then cut out the model trees and shrubs (Worksheet C). After cutting, tape short pieces of pipe cleaners to the bases and backs of your trees for flexibility and strength. Keep in mind that deciduous trees lose their leaves in fall. However, evergreens do not lose their leaves (needles). They are green all year. Plan how to landscape your plot with what you know about your trees, shrubs, and wind patterns. Lightly tape summer deciduous models in place. Lightly tape models of the winter deciduous trees directly behind the summer models. Tape the other tree and shrub models lightly in place.



8. Establish the noontime angle of the sun in your area for winter and for summer (see **Illustration 2**, which follows). Set up your light source several feet away from your home in the correct direction. Hold your light source at the noontime angle for the summer sun. Turn on the light and check your house and landscaping for the effectiveness of summer shading. How many windows receive direct sunlight at noon? Do your deciduous trees shade the house to keep it cool? Does your roof overhang provide shading from the summer sun? Does your landscaping channel cooling summer breezes toward your house? Make changes to the positions of your models as desired to improve your plot plan, landscaping, and the location of your house.

Illustration 2. The Solar Window. *(Illustration courtesy of the Wisconsin Energy Bureau)*



9. Now fold down your summer tree models so the winter models are visible. Set the light source at the noontime angle for the winter sun. Again, check your house and landscaping, this time for the effectiveness of winter solar heating. How many windows receive direct winter sunlight at noon? Do any trees block the sun's rays, preventing them from warming the house? Does the roof overhang allow the winter sunlight to pass through your windows? Do your evergreen trees break and slow those cold winter winds? Make changes to the positions of your models as desired to improve your plot plan, landscaping, and the location of your house.

10. Reminders and additional instructions:
- Take into account any requirements made by your teacher that are not specifically written into these instructions. You may be asked to build additional features into your design. Your teacher will probably also want you to tell others in your class about your design. Be prepared for these.
- Consider the questions you need to answer in your **Student Response Guide**. Verify that you can answer them all with your current design.
- Make any needed changes to your models and plot plan to finalize this activity.

- Take several good seasonal photos of your finalized passive solar home and plot plan.

Portions of the preceding text are courtesy of the *New York State Energy Project.*