Window Treatments for Energy Savings

If you've ever stood by a window on a sunny day or a cold night, then you know that windows have a lot to do with how comfortable your home feels. Heat moves from warmer to colder areas. Heat will enter through a window on a warmer day but escape through a window on a cold night.

Heat gets around in three ways. One way is radiation. Sunlight is radiation, and most of it passes directly through glass, warming the objects on the other side. Conduction occurs when heat is transmitted through an object. Glass is a good conductor, and transmits heat from warm air that touches it. Convection happens when heat is moved by moving air. When cold air slips in (infiltrates) around the cracks in the window frame, it displaces some of the warmer air in the room.

All three of these methods of heat transfer affect the comfort of people in houses and buildings. In this activity you will investigate the patterns of heat in your classroom and learn how windows affect a room's comfort. You will find out how to treat windows from the inside to make them more effective in conserving the energy needed to heat or cool your home.

Objectives

Students will:

- Determine the areas in a room which are warmest and coldest, and explain why,
- Determine the places where air infiltration occurs in a room, and explain why,
- Describe the functions of windows,
- List the kinds of energy-saving window treatments and explain the need for them,
- Research energy-saving window treatments in current books and magazines, and
- Recommend energy-saving window treatments for various situations, evaluating the advantages and disadvantages of each treatement.

Skills and Knowledge You Need

- Reading a thermometer
- Recording and graphing data
- Researching information in current books and magazines
- Taking notes

Materials

Lamp with uncovered light bulb, six Celsius thermometers, string and masking tape, colored pencils, a sheet of plastic, paper, or tissue (15 cm x 15 cm), a pencil, a fan, index cards, and current books, pamphlets, and magazines containing window treatment information

PROCEDURE

Part 1: Collecting Data

1. Turn on the lamp. Cup your hands near the bulb. *Safety warning:: Do not touch the bulb. It may be very hot.* Describe what you feel. If possible, stand next to a sunny window. Describe what you feel now.

2. Suspend six thermometers around the classroom using masking tape and string. Three thermometers should be hung close to the ceiling and three close to the floor. Make sure at least one thermometer is in front of a window. Record the position of each thermometer in Data Table 1 on Worksheet A.

   For example, Thermometer 2's position might be "on the back wall, 1 meter above the floor." Also record the outside weather conditions; for example, a partly cloudy day with a temperature of 50 C.

3. Divide the class into six groups. Each group should select a thermometer to read. Every 5 minutes read the temperature of your group's thermometer. Record the thermometer readings of all the groups in Data Table 2.

4. Graph the temperature data from each thermometer on the graph provided (Worksheet B). Use a different colored pencil for each set of data. Write the color used for each thermometer on the key.

5. Take a sheet of paper, plastic, or tissue and tape one edge to a pencil. Hold your "infiltration meter" 15 cm in front of the fan. Then hold it 15 cm behind the fan. Observe the results.

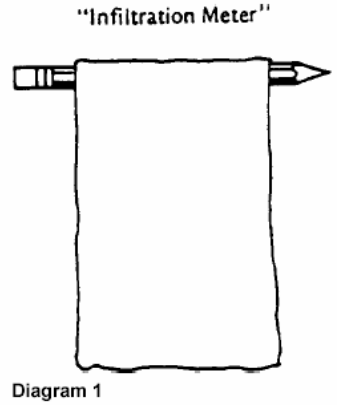


Diagram 1

6. Hold this "infiltration meter" in various positions around the edges of several closed windows, either in the classroom or at home. Observe what happens.

7. As a class, make a list of the functions of windows. List as many reasons as you can for why we have windows in our homes.

8. Define radiation, conduction, convection, and infiltration.

Part 2: Researching Window Coverings

9. Discuss how and when heat is lost or gained through a window. Be sure to include in your discussion such factors as
   - solar radiation,
   - the direction the window faces,
   - the time of day,
   - the season of year,
   - radiation, conduction, and convection,
   - ventilation,
   - infiltration, and
   - insulation.

10. Do the Reading Activity provided on Worksheet C.

11. Research the kinds of window coverings which can be used to admit more sunlight when needed to help heat the house, to block sunlight when needed to help cool the house, and to reduce heat loss from windows at night or during cloudy periods. Use current books, pamphlets, and magazines. Use index cards to list and take notes on the kinds of window treatments available for solar energy and energy conservation.
12. Read the three case studies provided on Worksheet D.
13. Use your notes and the Reading Activity to recommend a window treatment for each case study situation. Explain why you chose each window treatment.
14. As a class, discuss the advantages and disadvantages of the window treatments recommended for each activity.

QUESTIONS

1. What form of heat transfer (radiation, conduction, or convection) were you feeling when you placed your hands near the light bulb? When you stood next to the sunny window?
2. What happened when you held the "infiltration meter" in front of the fan? In back of the fan?
3. What happened when you held the "infiltration meter" at different positions around windows?
4. What caused the results you obtained when holding the "infiltration meter" around windows? What does the infiltration meter detect?
5. Describe the results you obtain from graphing room temperatures. Where was the room warmest? Coldest?
6. How did the temperatures in front of the window compare with those in other parts of the room? Why?
7. What is the function of windows?
8. What is window heat loss? How and when does it occur?
9. What is window heat gain? How and when does it occur?
10. List as many energy-saving window treatments as you can.
11. What window treatment did you recommend for each case study? Why?
12. What are the advantages of the window treatment you recommended for each activity? The disadvantages?

LOOKING BACK

You have learned how heat is lost or gained through windows. As energy becomes more expensive, controlling this heat exchange will become more important. One way to conserve energy is through window treatments. During cold weather, these treatments can be opened to allow sunlight in or closed to keep heat in. During warm weather, these treatments can serve an opposite function. They can be closed to keep sunlight and heat out or opened to allow cooling breezes in. When these window treatments are sealed at the edges to reduce air infiltration, they are even more effective.

Each window is unique. When selecting a window treatment, you should choose the kind of treatment which best meets your needs and tastes and best solves the window's problems. There are many kinds to choose from: draperies, shades, shutters, panels, and interior storm windows. Each varies in cost, attractiveness, effectiveness, and ease of use. The choice is up to you.

GOING FURTHER

1. Investigate the windows in your own home. What kinds of window treatments are being used now? What kinds of treatments would you recommend to increase energy savings? Design, construct, and install a new treatment in your own home.

2. Plan a window treatment to save energy in your classroom. As a class or FHA/HERO project, raise money to construct and install this treatment.

3. Investigate commercial window treatments which are designed to save energy. Compare their costs, R-values, effectiveness in reducing heat loss or gain, ease of installation and use, attractiveness, and durability.

4. Use your research to write a pamphlet or news article on window treatments for solar energy and energy conservation. Duplicate the pamphlet for distribution to community groups or submit the news article to school and community newspapers.

Worksheet A: Change in Room Temperatures

Date Table 1

Outside Weather Conditions (°C) _____
Thermometer Positions

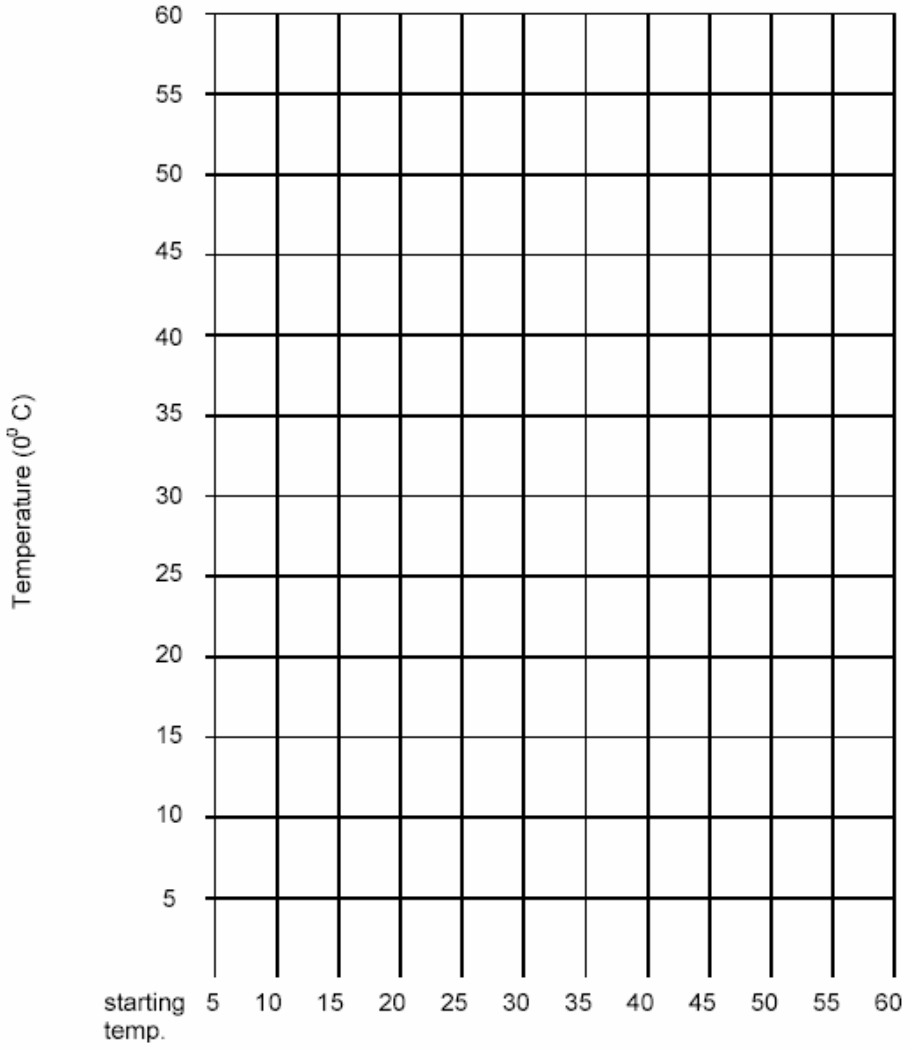
Thermometer	Position
1	
2	
3	
4	
5	
6	

Data Table 2

Room Temperature over Time
Temperature (°C)

Time (in minutes)	Thermometers					
	1	2	3	4	5	6
Starting Temperature						
5						
10						
15						
20						
25						
30						
35						
40						
45						
50						
55						
60						

Worksheet B: Change in Room Temperatures over Time



KEY

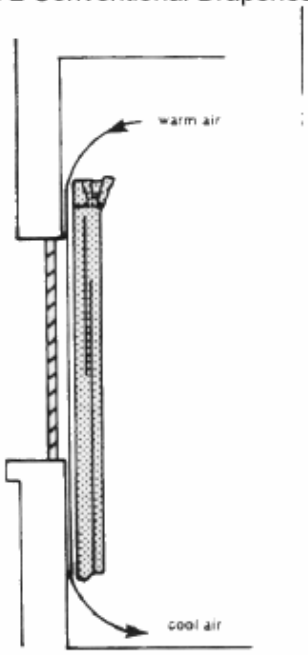
Thermometer	1	2	3	4	5	6
Color						

Worksheet C: Reading

Interior Window Treatments

Draperies

Diagram 2 Conventional Draperies



One common window treatment is the use of draperies. When drawn during cold weather or at night, draperies can reduce heat loss from a warm room. They can also be opened when the sun is striking the windows to take advantage of its heating effect. During warm weather draperies can be closed to help keep the room cool.

Conventional draperies, though, will not prevent much heat exchange through a window. The reason is simple. Draperies stand away from the window, leaving a space between drapery and window. In winter, for example, the air in this space is cooled by the window, drops towards the floor, and is replaced by warm air at the top. (See Diagram 2.) This continuous action creates a convection current, reducing room temperature near the window. In fact, a conventional drapery reduces heat loss from a room by only 10%.

To prevent this convention current from being set up, draperies should be fitted at the top or bottom. Most simply, this can be done by letting the draperies fall onto the windowsill or floor. For maximum effectiveness, the draperies should also be fitted at the top (with a cornice or by placing the drapery against the ceiling), sealed at both sides, and overlapped at the center. (See Diagram 3.) Velcro or magnetic tape can be used to attach drapes to the wall at the sides and bottom. This kind of drapery can reduce heat loss as much as 25%. Thermal draperies, with two layers separated by an air space, will reduce heat loss even further.

Diagram 3 Insulating Draperies

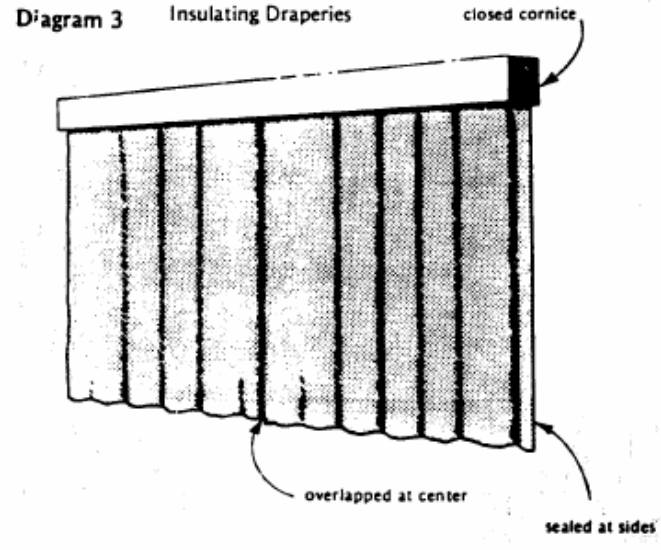


Diagram 4 Roller Shades, Summer Use

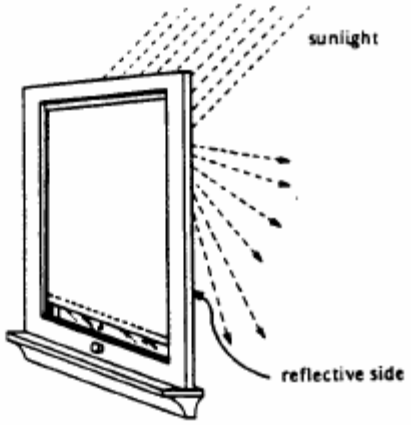
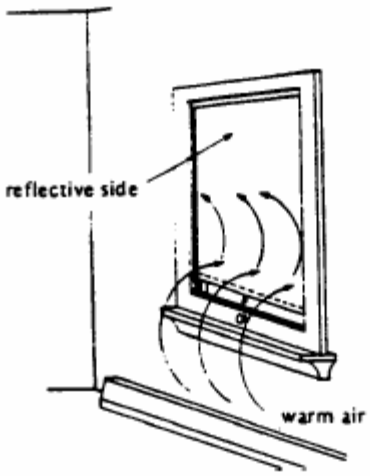


Diagram 5 Roller Shades, Winter Use



Roller Shades

This most common window treatment is an effective energy saver when properly installed and used. The shade blocks air flow and forms an insulating layer of air between the shade and the window. A roller shade reduces heat exchange by as much as 28%. By adding side tracks, tape, or closures to seal the shade to the window frame, heat exchange can be reduced by 45%. If the shade is made of or covered by a reflective material, this heat exchange can be reduced even further.

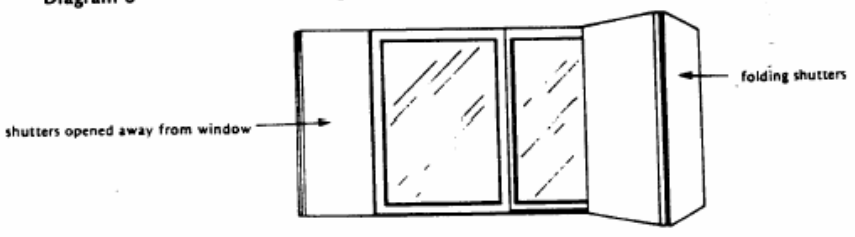
For greatest efficiency, a shade should be reversible, reflective on one side and dark-colored on the other side. The reflective material should always face the warmer side—outward in summer and inward in winter (See Diagrams 4 and 5).

In summer, shades should be lowered on sunlit windows to reduce solar heating. In winter, shades on the south side of a house should be raised during the day to increase solar heating, then lowered at night to reduce heat loss.

Insulating Shutters

Insulating shutters are a very expensive form of window treatment, but may reduce heat exchange by as much as 80%. They consist primarily of insulation, plywood or wood panels, a vapor barrier, and a decorative covering. Insulating shutters should fit tightly to the frame on all sides to prevent convection currents and to trap an insulating layer of air between the shutter and the window.

Diagram 6 Insulating Interior Shutters

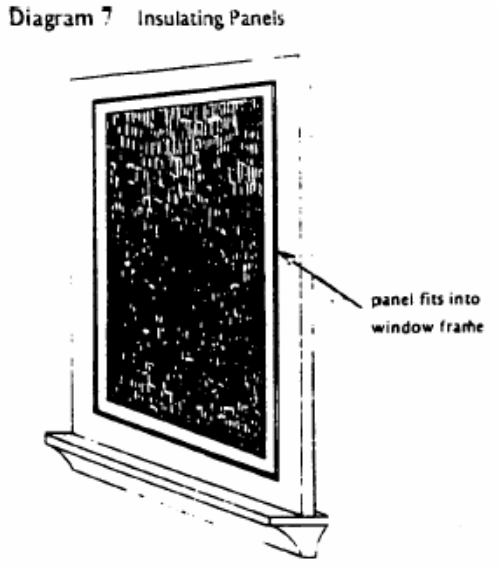


Insulating Shutters

Insulating Panels

Insulating panels, or pop-in shutters, are normally made of rigid insulation. They are inexpensive, whether you buy a kit or make your own. These panels can be popped into the windows as needed, but require storage space when not in use. They can be covered with decorative fabric or posters to make them more attractive. Insulating panels are made so that their edges seal tightly against the window frame. Seals can be made of magnetic tape or Velcro strips. This type of window treatment can reduce heat exchange by as much as 85%.

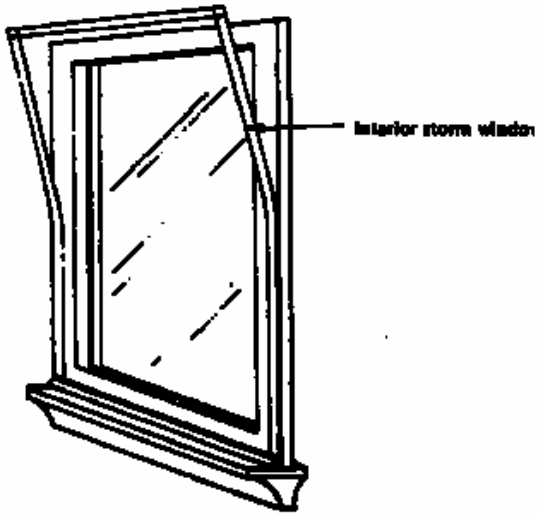
Diagram 7 Insulating Panels



Interior Plastic Storm Windows

A simple and inexpensive way to reduce heat exchange is the interior storm window. It can be made of polyethylene (like clear garbage bags) or rigid plastic. This window treatment can remain in place all winter and will reduce heat loss by as much as 50%. Flexible plastic can be easily and quickly taped to the window frames. Rigid plastic storm windows must be mounted in the same manner as insulting panels.

Diagram 8 Plastic Interior Storm Windows



Worksheet D: Case Studies

Case Study 1

For the winter months, Sue and John will be living in an apartment in New England. The apartment's living room has only one window area, a set of south-facing patio doors which lead to a small balcony. The doors are not tightly fitted and air leaks in around the edges. For now, Sue and John have a lightweight pair of draw draperies covering the window area, but they want the room to remain comfortable during the coldest winter nights. Because they are on a limited budget, this newly married couple does not have much money to spend on window coverings. What window treatment would you recommend for this couple's living room?

Case Study 2

Jim has just moved into a college dorm in a southwestern town. His corner room has two windows, one facing south and the other west. Although the room is air-conditioned, the heat from the sunlight entering the windows makes the room very uncomfortable by late afternoon. Jim would like to select a covering for his windows that will be attractive, but will also help to keep the room cool. What window treatment do you recommend for Jim's dormitory room?

Case Study 3

Karen and David have lived in their story-and-a-half Cape Cod home for over twenty years. Since their children are now grown and have recently moved away from home, the two bedrooms and bath on the second floor are unused during the winter months.

Winters are cold in the northern plains states where David and Karen live, and they are trying to reduce their home heating bills. They have closed off the second floor. Even though the upstairs windows have storm windows and weather-stripping, a large amount of heat still is being lost directly through the glass. David wants to find a type of window treatment which will reduce this heat loss. What kind of treatment do you recommend?

Worksheet E: Window Treatment Graphic Organizer

Window Treatment	Pros	Cons	Recommended for Case Study #