

Name: \_\_\_\_\_ Section: \_\_\_\_\_

## Activity 18: Uses of Solar Energy

### 18.1 Alternative Energy Sources

#### 1) Comparison of energy sources

List the advantages and disadvantages of the various energy sources discussed (fossil fuels, nuclear, tidal, hydroelectric, geothermal, wind, biomass) Which are ultimately forms of solar energy?

Energy	Advantages	Disadvantages
<b>Fossil</b>		
<b>Biomass</b>		
<b>Wind</b>		
<b>Tidal</b>		
<b>Hydroelectric</b>		
<b>Nuclear</b>		
<b>Geothermal</b>		
<b>Solar</b>		

## 18.2 Using Solar Energy

### 2) Solar insolation

- a) What is solar insolation?
- b) What factors affect how much insolation a given region receives?
- c) Which regions of the United States receive greater insolation? Why?
- d) What is the average solar insolation received in Columbus, Ohio, in the summer?

What is the average solar insolation received in Columbus in the winter?

### 3) Converting solar energy into thermal energy

We will attempt to boil water in a metal cup using a mirror and the radiant energy from a spotlight.

- a) Why is the mirror concave? On the diagram, draw light rays to indicate the path light rays follow after striking the mirror.



**Concave Mirror**

- b) Estimate where you should place the cup of water for maximum heat. Then check your estimate using a piece of paper to determine the focal point of the light.
- c) Group Discussion Question: Did the water in your cup start to steam or even come to a boil? Do you think this could be a practical method for converting radiant energy into thermal energy?

**4) Solar water heaters**

- a) How does the solar water heater seen in class work? Is a pump needed to circulate water through the heater's tubes? Why or why not?
  
- b) Would it make economic sense to use a solar water heater in Ohio?
  
- c) How should a solar collector be positioned in Columbus, Ohio, on a sunny day?
  
- d) If a solar collector is moveable, how should it be moved throughout the day?
  
- e) Should a solar collector be placed in a more horizontal or a more vertical position during the winter?
  
- f) Group Discussion Question: If a solar collector is moveable, how should it be positioned on a cloudy day?

**5) Converting solar energy into electrical energy**

- a) How efficient are the solar cells used in class?  
 Connect a 1 watt flashlight bulb to a solar cell and shine a standard 100 watt bulb onto the solar cell. Does the radiation from the 100 watt bulb produce enough electricity to light the small bulb? \_\_\_\_\_  
 If not, repeat the experiment by shining the 150 watt spotlight onto the solar cell. Does the small bulb light? \_\_\_\_\_
  
- b) Using your results from part a), estimate the efficiency of the solar cell.
  
- c) Using the efficiency you estimated in part b), calculate the average electrical power this solar cell could generate if it was positioned perpendicular to the Sun on a sunny day in summer in Columbus.

### 18.3 Energy Efficient Buildings

#### 6) Energy efficiency and insulation

Your instructor will demonstrate radiant energy from light bulbs directed at panels made of wood, aluminum, and plexiglass.

a) The thermometer that shows the most rapid increase in temperature is attached to which panel?

Prediction: \_\_\_\_\_ Answer: \_\_\_\_\_

b) This panel was heated by which of the three types of thermal energy transfer?

c) Your instructor will demonstrate a model "room" with and without insulation. What is the temperature increase inside the room when it is covered with insulation?

d) To retain the most heat inside of a home, should you choose insulation with a high or a low R-value?

e) Group Discussion Question: Is home insulation necessary in warm climates? Why or why not?

#### 7) Energy efficient homes

Describe the features of an energy-efficient passive solar home.