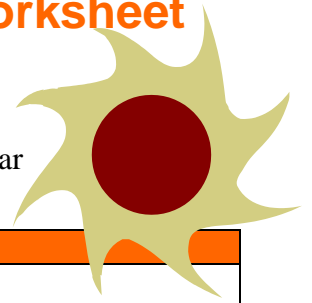


Group name: _____ Date: _____

Team members: _____

Solar Water Heater Design and Analysis Worksheet



Part 1 — Design

Under the constraints of the materials listed below, design a device that uses solar energy to heat water. As you do this, describe the function of each specific part.

Material	Function
plastic tubing (2 ft)	
soft copper tubing (3 ft)	
water container	
insulation	
aluminum foil	
cardboard	
plastic sheet	

Sketch:

Briefly explain how your device works to accomplish its task. Provide additional sketches if necessary.

Part 2 — Build

Part 3 — Test

Procedure:

1. Measure 1 liter of water and pour it into your water container. Either plug the outflow of the system or hold it above the tank to prevent water loss. Obtain four Styrofoam cups to collect the water after it has been heated and minimize its heat loss. To maximize their insulating ability, use one cup inside another (double up).
2. Prepare to circulate water through the system. Set the system on a chair to provide room below to catch the water coming out of the copper tube.
3. Start timing as soon as you start the water circulating. As your cup fills with water, exchange it with an empty one and pour the water back into the water tank. Try not to let any water escape. Have one group member record in the table below the tank water temperature every five minutes.

State	Elapsed Time (mins.)	Temperature (°C)	Change in temperature (Δ°C)
Initial	0		
1	5		
2	10		
3	15		
Final	20		

Calculations

1. Convert the initial volume of water to mass using the density of water (1g/mL).

2. Calculate the heat gained by the water using the equation below:

Show your work and remember to label the units correctly!

$$Q = mC_w\Delta T \quad \text{Given: } C_w = 4.186 \frac{\text{Joules}}{\text{gram} \cdot K}$$

Your design's heat gain:

Part 4 - Evaluate

Compare your value to those obtained by three different teams. Also, record notes about each group's design in the table below.

Team	Their Heat Gain	Design Notes

Identify reasons for differences in values obtained for your device compared to those of the other groups.

Identify any sources of error in the model solar water heater experiment.

Provide reasons for using solar energy rather than some other energy source (such as coal, natural gas, electricity).

What kind of effect would using a solar water heating system in your house have on the environment? On your utility bill?