

# Solar Water Heater

This experiment is only suitable with adult supervision in a classroom situation or similar. It requires the use of or access to tube benders and soldering equipment. Solar water heaters use the sun to heat water in collectors mounted on the roof of a house. One type of solar water heater uses the different temperatures of the water in the collector to create a circulation system. As water in the collector heats, it becomes lighter and rises into the tank above. Meanwhile, cooler water in the tank sinks down pipes to the bottom of the collector. The storage tank must be above the collector for this system to work.

## What you need:

### Collector

- 25 cm square piece of galvanised sheet metal (the thinnest available)
- 50 cm square piece of cardboard
- Flat black paint
- 25 cm square piece of insulation (styrofoam, corrugated cardboard, newspaper etc) at least 8 cm thick
- 1 metre soft copper tubing about 1 cm diameter
- 40 cm square sheet of heavy weight clear plastic (not cling wrap)
- Sticky tape or masking tape
- 1.5 m clear plastic tubing with an internal diameter the same as the external diameter of the copper tubing

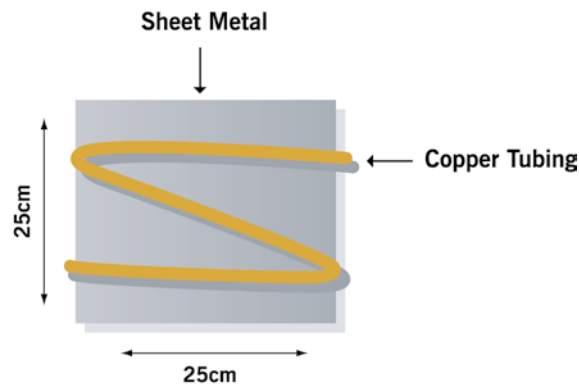
### Water Heater

- 500g - 1 kg tin (eg coffee tin) with plastic lid
- Two 5 cm pieces of soft copper tubing about 1 cm diameter (must be same diameter as the copper tubing used in collector)
- Thermometer
- Cardboard box, slightly larger than (coffee) container
- Insulation material (Styrofoam, corrugated cardboard, newspaper etc)

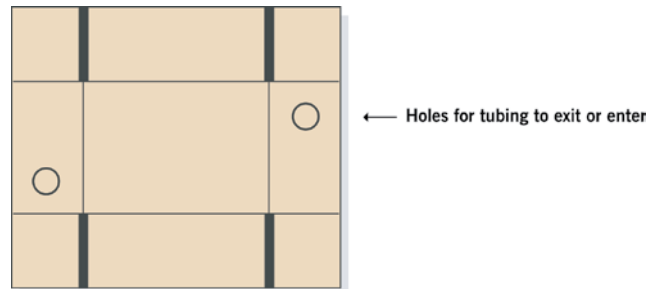
## What you need to do:

### To Make the Collector

1. Bend the copper tubing carefully into an S-shape using a tube bender to avoid kinks.
2. Lay the copper tubing onto the galvanised sheet metal and solder it in place.



3. Paint the plate and tubing with the flat-black paint.
4. Draw lines on the cardboard.



5. Cut on the heavy lines, and fold on the thin lines, so the cardboard can be folded into a box.
6. Place the insulation in the bottom of the box and check height where the collector will sit on the insulation.
7. Cut holes 1 cm in diameter in the cardboard sides of the box at the position where the collector metal tubing will enter and exit.
8. Place the collector (metal sheet with tubing) onto the insulation.
9. Fold and tape box tightly closed, cover with clear plastic taped tightly in place.
10. Cut the plastic tubing into two pieces, one slightly larger than the other and connect each piece to the copper tubing entering and exiting the collector.

**To Make the Water Tank**

1. Punch two holes 1 cm in diameter on opposite sides of the coffee tin. One hole 2.5 cm from the top and the other, 2.5 cm from the bottom.
2. Insert the 5 cm pieces copper tubing in both holes and solder the joints watertight.
3. Cut holes in a cardboard box that will align with the tubes entering and exiting the tin.
4. Put the tin inside the cardboard box, with the tubes sticking out the holes in the box.
5. Put insulation around the coffee tin.

**To do the experiment:**

1. Set up the collector in position to catch the full sun for the full period of the experiment
2. Ensure the bottom of the water tank is placed at a higher level than the collector.
3. Connect one piece of plastic tubing to the outlet (lower tube) of the water tank
4. Carefully run water through the tubes of the collector until all the air is gone.
5. Connect the inlet plastic tubing from the collector to the water tank's inlet (top tube).
6. Fill the coffee tin with water to above the level of the inlet (top tube).
7. Measure and record the water temperature and replace the lid.
8. Measure and record the water temperature every 20 minutes for the period of your experiment.

Time	Temperature °C
At start of experiment	
After 20 minutes	
After 40 minutes	
After 1 hour	
After 80 minutes	
After 100 minutes	
After 2 hours	

### Consider these questions:

1. How hot did the water get in 20 minutes?
2. Graph the temperature against time - Is the temperature rise constant (linear)?
3. What was the highest temperature you recorded?
4. Can you detect the water flow (viewed through clear plastic tubing) in the system using chalk dust or food colouring in the water?
5. Would the solar water heater work if the storage container was placed lower than the collector? Explain why?
6. Will the solar water heater work in reverse on a cold night?