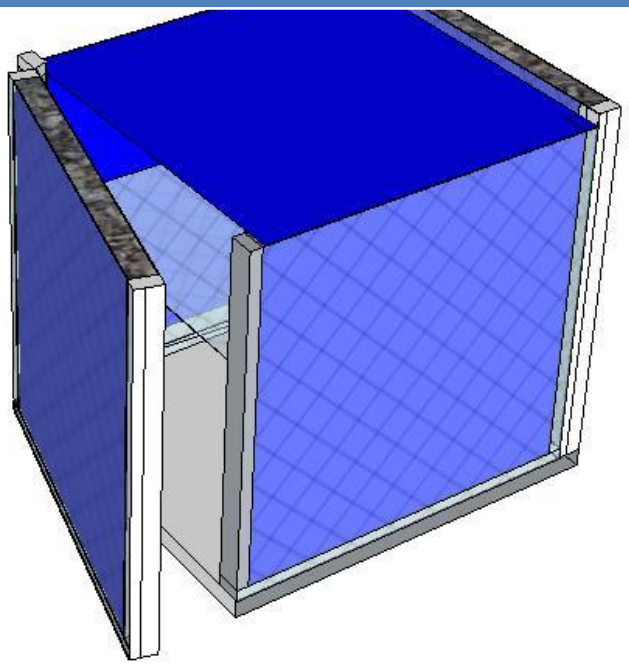
Charcoal Cooler

Instructions for Device Construction



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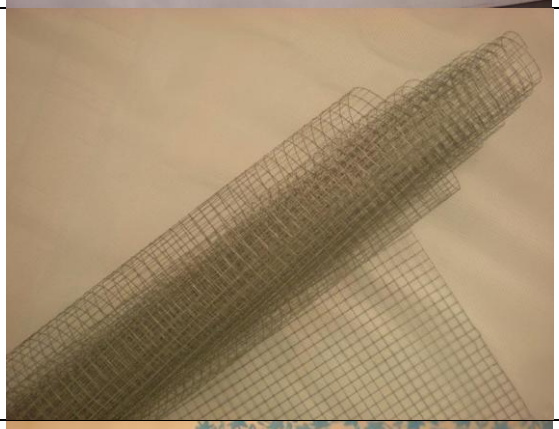
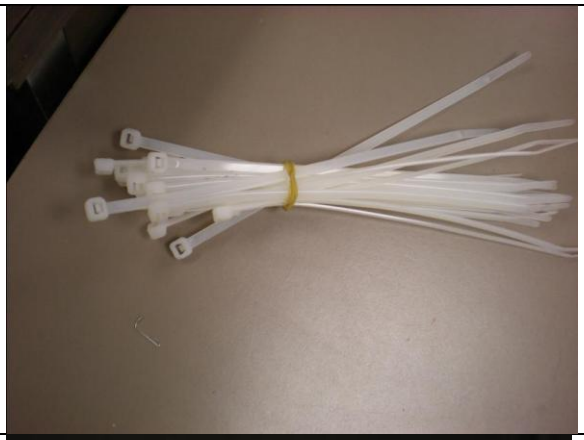
Materials

Table 1 gives are the materials used for the built prototype. The quantities and dimensions given are for a 1ftx1ftx1ft charcoal cooler, and must be increased if the dimensions are to increase. Alternate materials are also given.

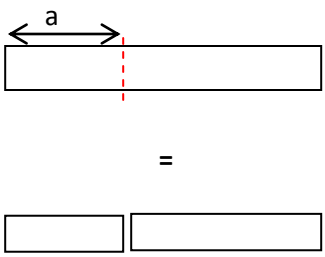
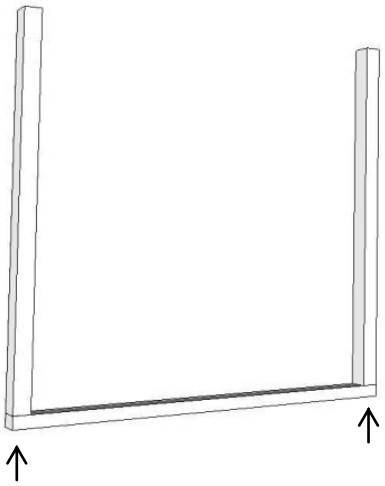
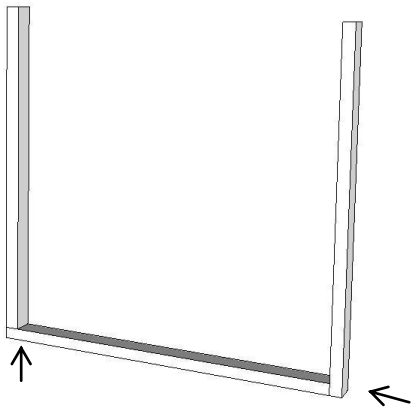
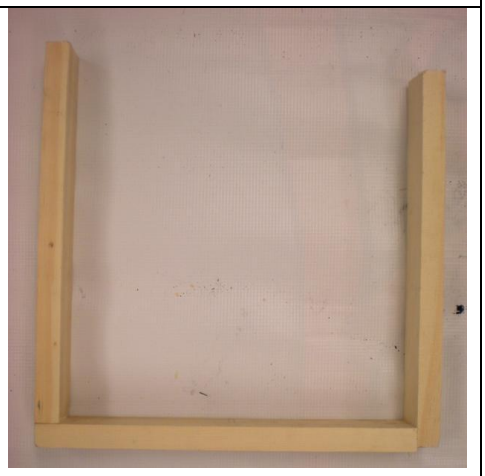
Table 1: Required Materials

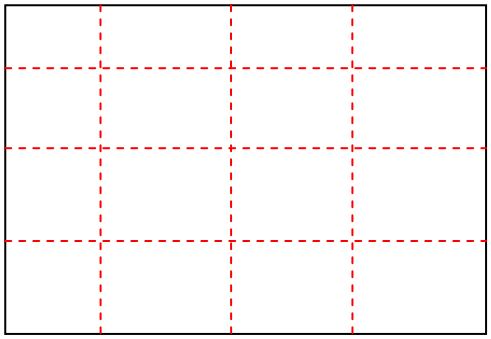
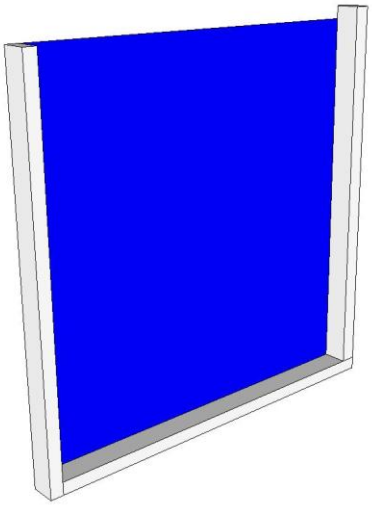
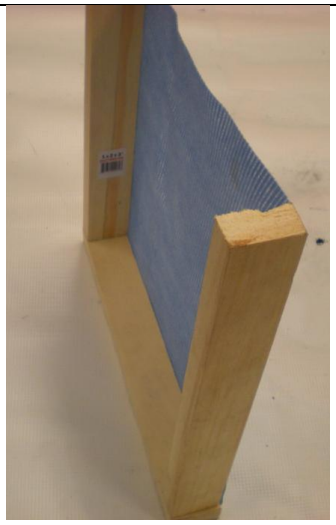
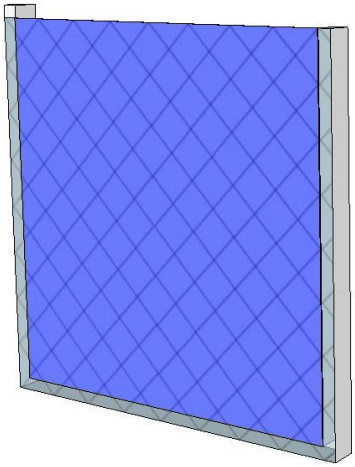
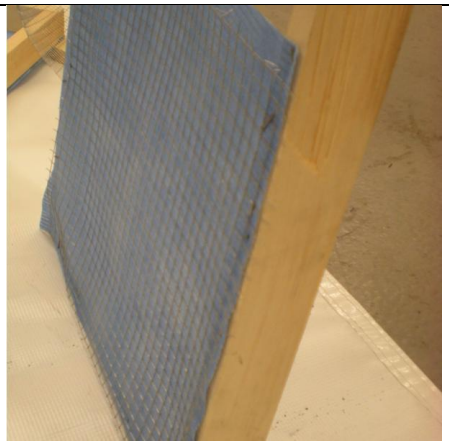
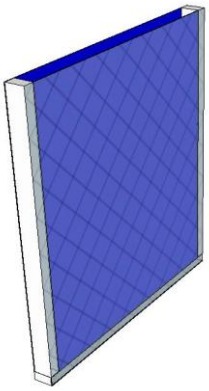
Material	Picture	Alternate
Wood 12 ft of 1cm x 2cm Timber		Wood of another size is usable. Bamboo or any other structural material will also work.
Mesh Chicken Wire		
Cloth Jute cloth or canvas		Another absorbent cloth material may be used.
Nails Finishing and carpentry nails		Screws can be used in place of carpentry nails. If available, a staple gun and staples to replace the finishing nails would make construction significantly easier. Twine or rope can be used to lash frame together if necessary.

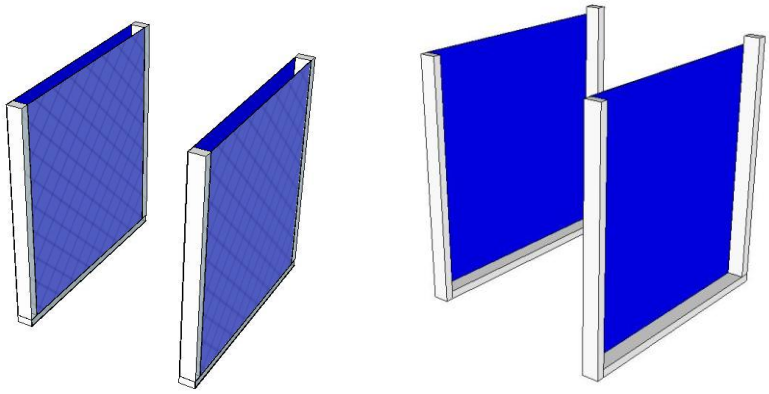
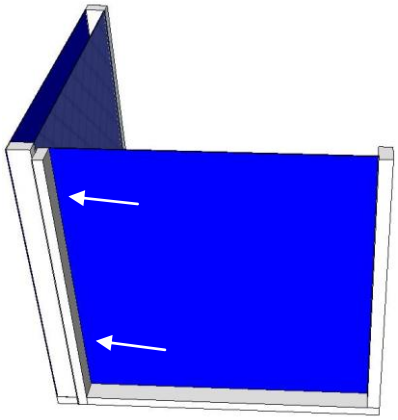
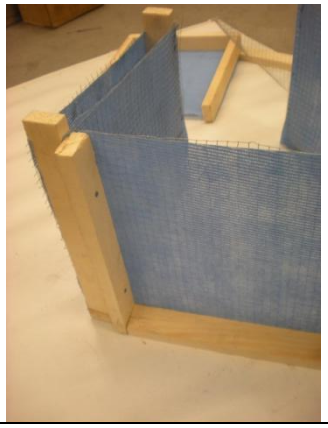
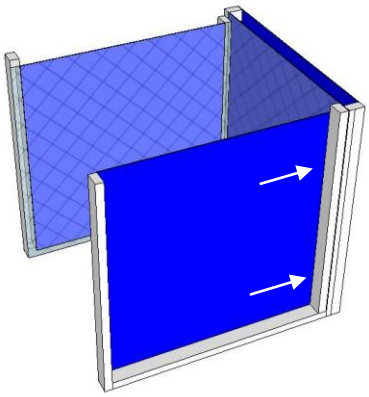
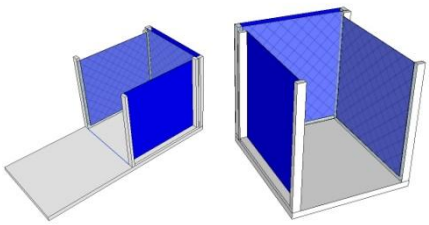
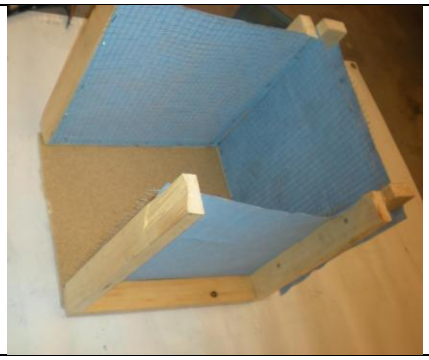
Charcoal Approximately 4 kg		Another absorbent material will suffice as long as it allows for air circulation, can hold a substantial amount of moisture, and can be contained within the frame of the cooler [3].
2 Hinges		
1 Solid Board 1 ft x 1 ft (dimensions of the base of the cooler)		Woven bamboo or reeds can be used to replace the board.
1 Plastic Hose Approximately 10ft with ½ to 1 inch in diameter		Alternately, tins can be placed on the top of the cooler if hose is unavailable. This modification will be discussed further in the construction instructions.

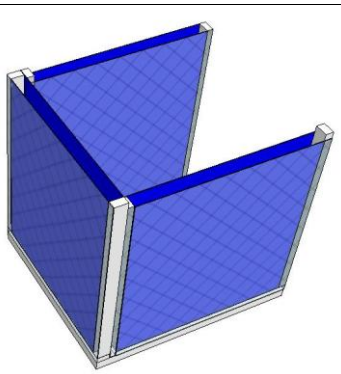
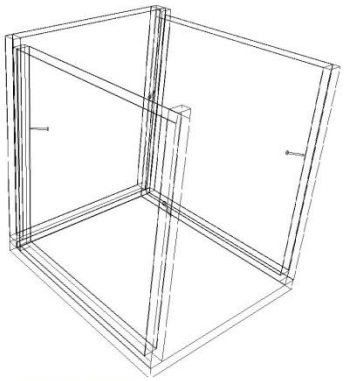
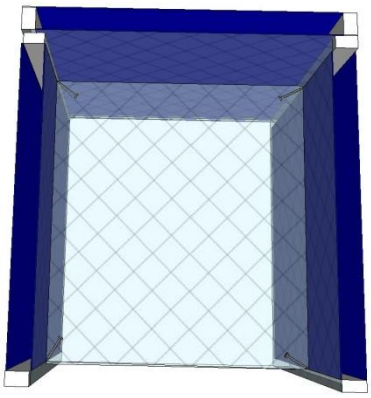
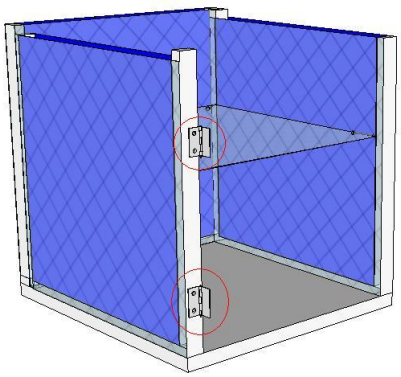
<u>Ties</u> Approximately 8 plastic tie devices		Twine or string is a good alternative for the ties.
<u>One Bucket</u> Any size.		Any device that can hold water can be used. If tins are used instead of hose the bucket is unnecessary.
<u>Tools</u> A hammer, saw and scissors or wire cutters are required		A screwdriver can be used if screws are substituted for nails. A staple gun would assist with construction. If twine is used to lash frame together, a hammer is not required.

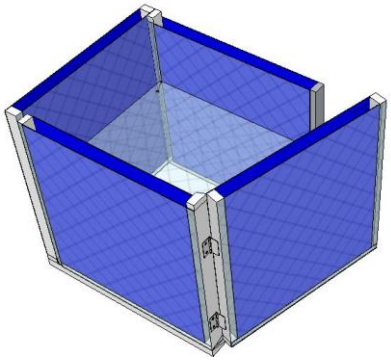
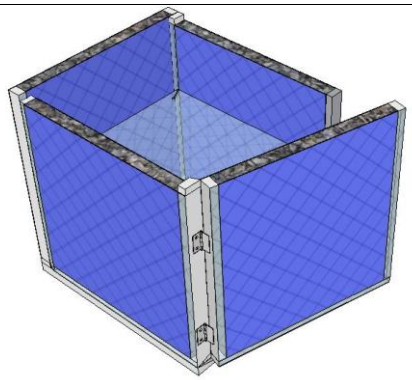
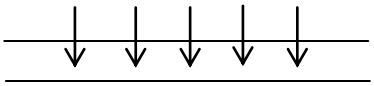
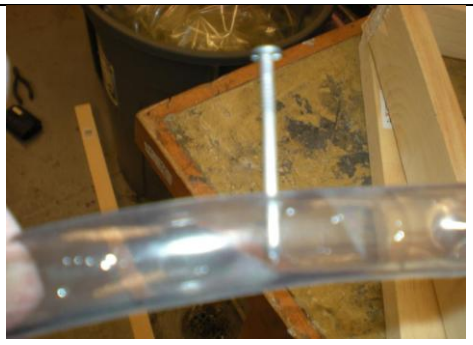
Construction Instructions

Step	Instructions	Schematic	Image
1	Choose dimensions (length, width, and height) and cut wood. The device requires 2 pieces of each the length and width, and 8 of the height.		
2	Create 2 U shaped frames (U-1), with the thick part of the timber forming the thickness of the frame. Nail the base to the other two pieces as shown in the figure by the arrows.	 U-1 Frame	
3	Create 2 more U shaped frames (U-2). The thick part of the timber should still be the thickness, but this time attach together as shown by the arrows in the image.	 U-2 Frame	

4	Cut the jute cloth and chicken wire to fit the four frames that were created. This should correspond to pieces about 1ft x 1ft. 8 pieces of jute cloth and 9 pieces of chicken wire are required.		
5	Fasten the Jute cloth to one side of each frame using the finishing nails. Place one nail in each corner, and additional nails as required. A staple gun and staples could also be used for the fastening.	 All Frames	
6	Fasten the chicken wire on top of the Jute cloth of each frame. Fastening nails can be used, but must be bent over the wire mesh to hold it in place. Care should be taken when handling the mesh wire as edges are sharp.	 All Frames	
7	On each of the U-1 frames, fasten both the jute and finishing wire to the other side.	 U-1 Frame	

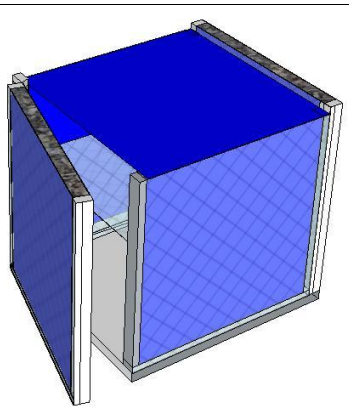
	Now there should be: 		
8	Nail the U-2 frame to the U-1 frame to form a three dimensional L-shape. Nail locations are indicated by the arrows.		
9	Nail the other U-2 frame to the U-1 frame to form a three dimensional U shape.		
10	Measure the board to fit the bottom of the cooler. Cut the board at the appropriate length. Nail the board onto the bottom.		

11	Fasten the jute cloth and chicken wire to the remaining two sides on the outside of the cooler.		
12	Attach three nails on each of the edges of the frame, pointing diagonally towards the middle of the cooler.		
13	Using a piece of chicken wire, form a shelf in the middle of the box. This is done by weaving the mesh onto the protruding nails. Test the shelf by putting some pressure on it to see if it will be able to hold food. As a substitution, a board may be used to form the shelf, or woven reeds/bamboo, however a non solid material will be more effective.		 
14	Attach the hinges to the open face of the cooler.		

15	Attach the remaining U-1 Frame to the hinges to form a door for the cooler. If the door does not close, a latch can be installed to hold it closed as necessary.		
16	Fill the cavities formed by the jute cloth and chicken wire with charcoal. The charcoal should be evenly dispersed throughout the cavity. Charcoal should be in chunks about 0.5cm in diameter [1]. The mesh wire should be strong enough to hold the charcoal in place and prevent the cavities from bulging.		
17	Tie the end of the hose. Pour some water into the hose to ensure the tie is sufficient to block the end of the hose. If tie is not sufficient, a stopper must be used to prevent water from flowing through the hose.**		
18	Poke holes along approximately 4' of the hose. The holes should be spaced about 0.5-1cm apart and can be made using a nail. The size and spacing of the holes takes a bit of experimentation and depends on the rate of evaporation for the given climate. The charcoal should be kept continually moist, but should not be so wet that it is dripping out the bottom of the cooler. The flow rate of water though the holes should therefore equal the rate		

	of evaporation. If the holes made are too large, candle wax can be used to fill them, and new holes can be created through the wax with a pin [1].		
19	Starting at the opening of the door, lay the hose over the open sides of the box. Fasten the hose in place by using the ties to attach the hose to the mesh wire. Ensure that the holes are pointing down into the charcoal filled cavities.		

The device should now look like this:

20	Place cloth or woven reids across the top of the box and fasten it in place.		
21	Attach the free end of the hose to the base of an elevated bucket. As the bucket is filled with water, the water will trickle into the cavities, mositening the charcoal and cloth material.		

** If hose is unavailable and tins are used, the tins can be fastened to the top of the frame, with holes poked by nails on the charcoal cavities. If this method is used it is recommended that the tins have lids to prevent evaporation of the water from the surface of the tins.

Device Operation

Produce can be placed on the shelf or on the bottom of the cooler. The device should be placed in the shade with one side facing into the wind. Artificial air circulation with a fan may also be used. Very little maintenance is required however when first constructed the cooler should be monitored to ensure effective moistening of the charcoal.

References and Additional Resources

[1] Rusten, Eric. "Understanding Evaporative Cooling." VITA 1985. Accessed Online: April 8th 2010. Available: <http://www.fastonline.org/CD3WD_40/VITA/EVAPCOOL/EN/EVAPCOOL.HTM>

More information including scientific details and a CAD file can be found online at www.appropedia.org/Charcoal_Cooler.