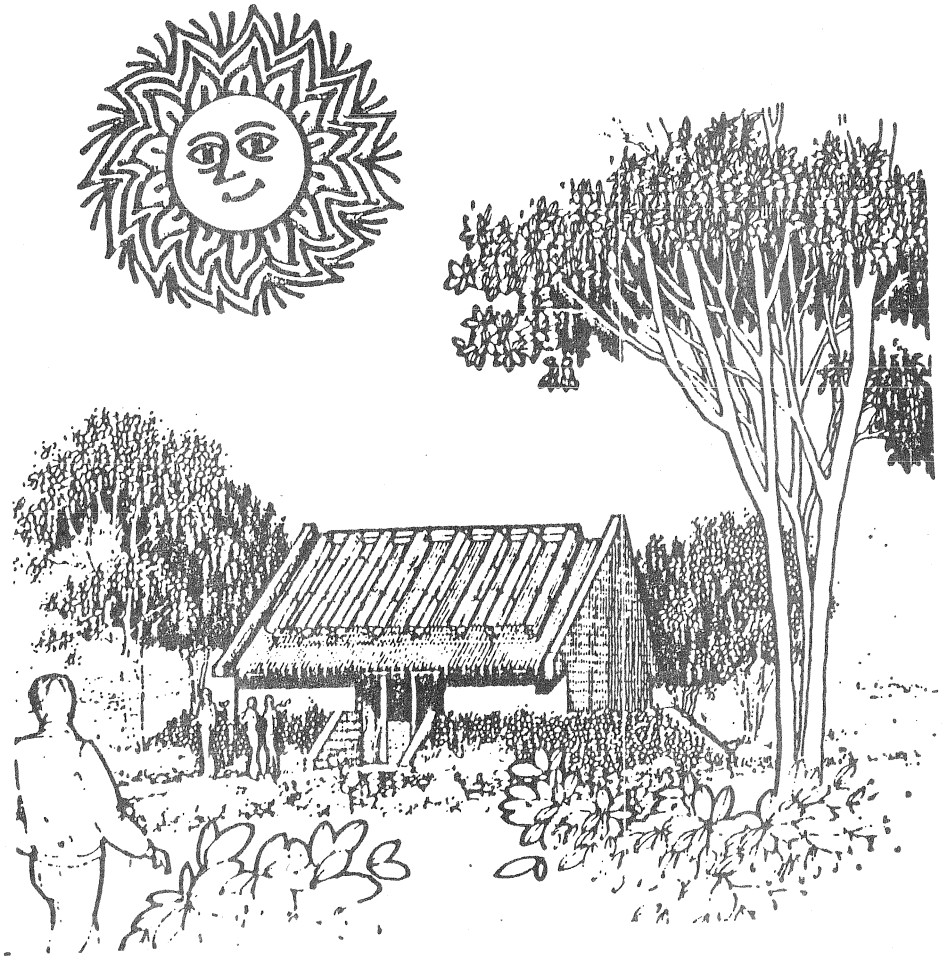
TRANSPORTATION

ENERGY INPUT
SOLAR COOKER



NAME_____

DATE_____

PERIOD_____

TRANSPORTATION
SOLAR COOKER
EVALUATION

CRITERIA	POSSIBLE	EARNED
CONSTRUCTION		
- Construction grading sheet (see following page for details)	35	_____
- Use of materials	10	_____
OPERATION		
- Orientated properly	5	_____
- Cooking effectiveness	10	_____
TOTAL	60	_____

GRADE BREAKDOWN

56 - 60 A

51 - 55 B

45 - 50 C

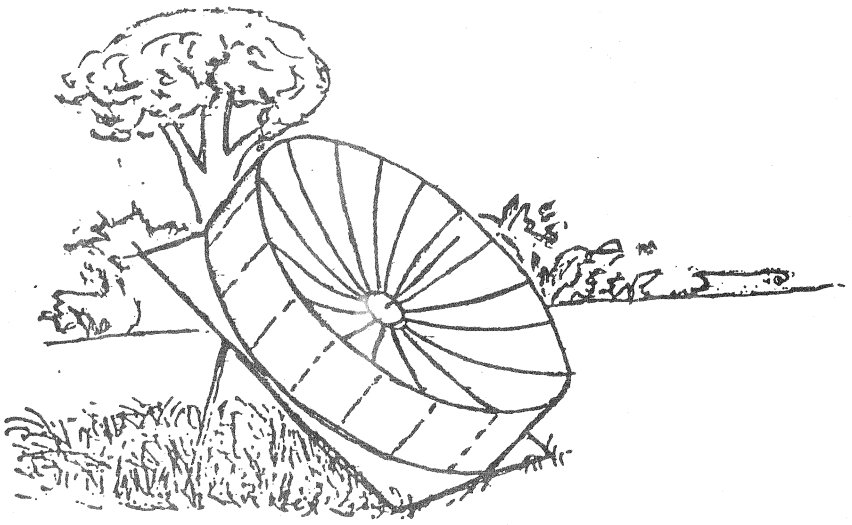
40 - 44 D

CONSTRUCTION GRADING

Instructions : After you complete each individual criteria have your instructor initial, date and grade each one.

CRITERIA	INITIAL	DATE	POSSIBLE	EARNED
Preparation				
Cardboard brought on time	_____	_____	5	_____
Cutting and Assembly				
- 4' x 4' base piece cut	_____	_____	2	_____
- Layout for reflector ribs	_____	_____	2	_____
- 2 main ribs cut	_____	_____	2	_____
- Attach 2 mainribs	_____	_____	2	_____
- 12 half ribs cut	_____	_____	2	_____
- Attach 12 half ribs	_____	_____	2	_____
- 16 rect. filler pieces cut	_____	_____	2	_____
- Attach 16 rect. filler pieces	_____	_____	2	_____
- 16 Poster board framework cover cut	_____	_____	2	_____
- Attach 16 poster bd.frame work cover	_____	_____	2	_____
- Attach 16 Aluminum foil	_____	_____	2	_____
Stand and Support				
Adjustable support	_____	_____	5	_____
Stand	_____	_____	5	_____
		TOTAL	35	_____

TRANSPORTATION
REFLECTOR COOKER
ACTIVITY



A stove made of paper sounds as practical as a pitcher carved from ice, but that is going to be our project. Constructed almost entirely from cardboard, this reflector cooker will boil steaks, grill hot dogs, fry bacon and eggs, and make hotcakes and coffee. It will also heat the water for doing the dishes. All that is necessary is clear weather, because this stove cooks with the sunshine!

Stop to think about it for a minute and you'll remember that every time we cook - be it with gas, electricity, or charcoal - we indirectly use the sun's energy, which has been stored up and reconverted to heat. Basically, then, our solar stove's fuel is nothing really new. Even the use of direct sun heat for cooking goes back many years. Sun-dried foods have long been eaten, and crude solar stoves were built a century ago. Besides, who hasn't heard of cooking an egg on the sidewalk on a really hot day?

In recent years, however, many advances have been made in the design of solar cookers. Today there are commercial models on the market that are fine for campers or for patio use. One umbrella-like design folds up for easy carrying and

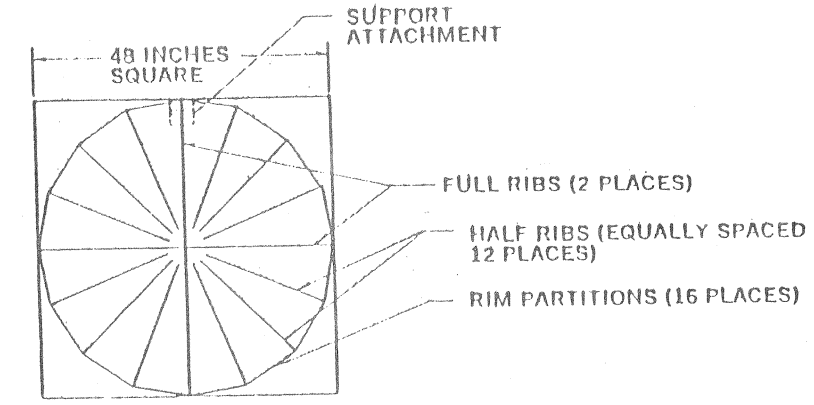
storage and also provides an answer for the skeptic who wants to know what you do when it rains! Such a cooker is just the thing for trips. If you are dubious about how well the sun can cook a meal, or if you don't have the cash to buy a ready-made stove, get busy and build the one described on the following pages. At most, it will cost ten dollars. If you use discarded cartons and other salvage material, the outlay will be only a fraction of that.

MATERIALS

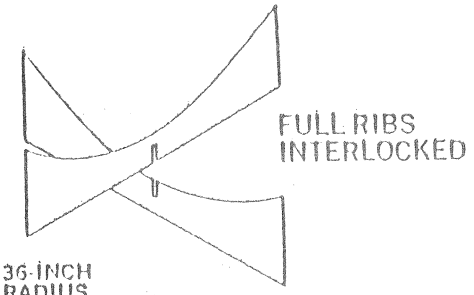
Cardboard - as required
Poster board - two sheets
Aluminum foil - one roll
Plywood - one piece, 18 by 24 inches
3/4-inch aluminum tubing - approximately 64 inches
3/4-inch mounting flange - one
Grill - one
Curtin rod - one
Broomstick - four feet
Clothesline - one foot
Glue - as required
Masking tape - as required
3/16-by-1-inch bolt with wing nut - one set

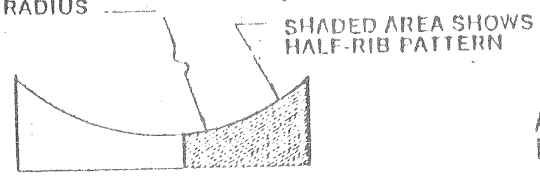
The reflector framework, is cut from fiberboard, approximately 3/16 inch thick, the kind large cartons are made from. Some postor board and aluminum foil will complete the cooker itself. A grill (for hot dogs, hamburgers or pans) is made from plywood, some tubing, and an inexpensive hand grill that costs about 50 cents.

Study the plans, as located on the next page, first to get the over-all picture and to see how much material will be needed. Get all the materials ready then begin construction. An eager beaver can do the job in 10 class periods or so and begin

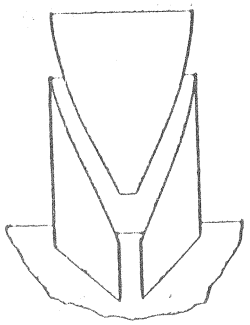


BASEPLATE & RIB LOCATION

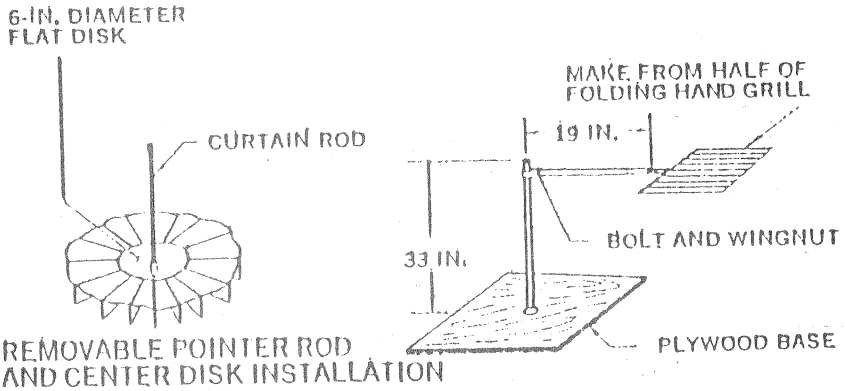




RIB PATTERN



ASSEMBLY OF POSTER-BOARD SECTIONS



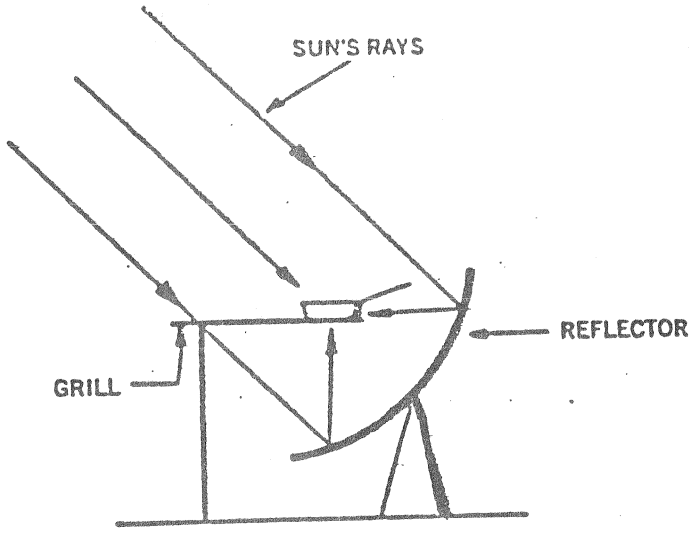
REMOVABLE POINTER ROD AND CENTER DISK INSTALLATION

REFLECTOR SOLAR COOKER

sampling outdoor cooking 'a la sun right away.

First, cut a base piece 4 feet square from the 3/16-inch cardboard. We will mark the layout with the reflector ribs right on this base. With a pencil and a piece of string, draw a 48-inch diameter circle. This is the size of our finished cooker will be. Next draw two lines through the center of the base, perpendicular to each other as shown on the plans. These mark the location of the main ribs, which we will make next.

A word about the principle of our reflector cooker will be helpful before we proceed any farther. The sun stove simply focuses all the sun's rays that strike its surface onto the bottom of the grill. Even on a clear winter day the 12 square feet of area in our cooker collects a lot of "warmth," which when shrunk into the 1-foot area at the grill becomes concentrated "heat'."



Principle of the reflector cooker.

Giant solar furnaces use curved reflectors too. They generate thousands of degrees of heat at their focal points , using the same principle. To do this they must be very accurately made and of parabolic shape. This specially shaped curve reflects all the ray's onto one tiny spot and gives the furnace a concentration ratio of many thousands to one. Obviously we don't want such high temperatures, for they

would melt our pans.

Our reflector will use a radius of 36 inches instead of a true parabolic curve. This results in a larger spot at the focal point . Besides this, we will use a number of wedge-shaped sections instead of one bowl-shaped relfector. Thus our focal spot will be roughly the size of the cooking pan, which is just what we want.

Now that we know the why of what we are doing, let's draw to main ribs as shown on the plans the page before. Cut these carefully, using a sharp linoleum knife, pocketknife, or modeler's razor knife or band saw! Be sure to plan ahead so as not to waste material as you lay out the ribs. Each of the main ribs has a notch at the center. Notice that one is on the top and one on the bottom so that they will interlock.

Using a full rib as a pattern, mark out 12 half ribs as shown on the plans. Before cutting these, cement the full ribs to the base plate on the lines previously drawn. Wood glue or a good household cement will work well. While the parts are drying, cut out the remaining ribs.

Three half ribs fit between each quarter section of the circle. Glue these in place, lining up the end of each one with the cirlce we drew on the base plate. While they are drying , cut the rectangular filler pieces of cardboard. As the plans show, these fit between the outer tips of the ribs to complete the framework.

When the framework is thoroughly dry, we are ready to put on the wedge-shaped pieces of poster board. Since these form the curve that will reflect the sun's rays, we use poster board that is thin enough to bend easily, yet has sufficient body to hold the proper shape. Lighter cardboard would have a tendency to ripple and wave.

By means of cut-and-try methods, trim one piece of poster board so that it covers the space between two ribs, with about 1/8-inch overlap all around. Do not cement this in place yet; it will be our pattern for 15 more pieces. Cut them carefully, making sure they will cover any of the spaces between ribs. (In spite of

care, there may be slight inaccuracies in the framework.) It is better to have the poster-board pieces a bit too large than too small.

With all the pieces cut we can now begin to cement them in place. Since butting the joints smoothly against each other would be difficult, we will glue eight pieces in alternate spaces first. Spread glue along the tops of two ribs and the interveneing filler piece, then lay the poster-board wedge in place and carefully press down so that it touches the ribs at all points. The glue will dry well enough in a minute or two so that you can go on to the next piece. Don't forget to leave every other section open.

Now we can cover the open spaces with our remaining eight pieces of poster board. These will of course lap over the edges of the pieces already glued in place, thus making a strong joint. If you run into difficulty at the center where all the points come together, simply trim them off an inch or two. The hole left can later be covered with a separate piece of poster board.

For added strength, seal all the joints with masking tape. While this isn't absolutely necessary, it will make a sturdier cooker. The reflector is now ready for application of the aluminum foil that will give it the mirror-like finish we need to collect heat for cooking.

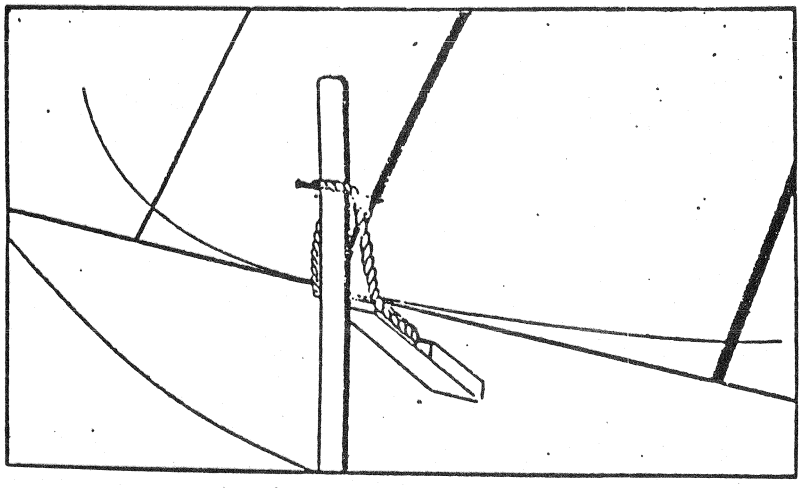
Cut out 16 pieces of smooth-surfaced aluminum foil -- the kind used in the kitchen for wrapping food. These should be slightly larger than the poster-board pieces to assure complete coverage of the reflector surface. Use rubber cement to stick the foil to the poster board, and be sure to have the shiny side up. Work carefully and try to keep the foil smooth, but don't worry if the finished job is not perfect.

We will now install a marker for the focal point of the reflector so that we will know where to place the grill for the fastest cooking. This is simply a small, inexpensive curtain rod of the type used on kitchen doors. It consists of two tubes, one fitted inside the other. We will cut a short length of the larger tube and insert it

into a hole punched in the center of the reflector. Better still, use a drill the same size as the tube or slighter smaller to give it a snug fit. Now cement the tube in place.

The smaller tube will fit into this "holder" and can be removed for easier handling when not needed. As we mentioned before, the focal distance from our reflector is the proper place for mounting our grill. With a spherical reflector the focal length is half the radius, or in this case 18 inches. As a double check, aim the reflector at the sun and adjust the tilt until there is not shadow visible from the pointer rod should be cut to this length.

Cut out two squares and one rectangle of cardboard as shown by the dotted lines on the plans and cement them to the back of the cardboard base. The squares go first, and then the rectangle. After these are well dried, run a short length of clothesline through the slot and tie the ends in a square knot. Drill holes through a 48-inch length 1-inch dowel (broomstick or tubing), spacing the holes about an inch apart half way down the dowel. Insert a nail to engage the loop of clothesline. We can now set up our reflector so that it will stand alone.



Attachment of adjustable support.

To make the grill, first cut a plywood base 18 by 24 inches. Any thickness from 1/2 to 1 inch will do. Mark the center and install a mounting flange for the 3/4-inch

aluminum-tubing vertical support, which is 40 inches long. The adjustable arm is also aluminum tubing, 24 inches long. Flatten one end as shown and bend around a piece of pipe or a broomstick to make the collar, which fits over the vertical support. Drill a 3/16-inch hole as shown and insert a bolt and wing nut. The other end of the adjustable arm may now be flattened. Be careful to keep the flat area at right angles to the collar so that the grill will be horizontal when installed. Slide the grill in place and the solar cooker is complete.

Now that the work is done the fun starts. Positioning the reflector is simple if you follow these directions. Now tilt it back until the shadow of the pointer rod vanishes as it did when we checked for focal length . This means that the reflector is aimed perfectly and that all the sun's rays will be bounced right where we want them. You may also check for the focal point by using your hand.

Holding the reflector in this position, slip the dowel broomstick through the rope loop and put the nail through the hole just below the loop. With the reflector on its own feet you can now put the grill in place. Loosen the wing nut on the adjustable arm and move it up or down until the grill rests just above the tip of the pointer rod. As a double check, pass your hand quickly just above the grill. It should be hot, ready for you to start cooking.

The grill surface itself is fine for cooking hot dogs, burgers, or steak. Grease will drip on to the reflector but will not harm it. For bacon and eggs, hotcakes, and the like, place a skillet on the grill. And if you like your steak seared quickly to keep in the juice, use the skillet for them too. By putting it on the grill a few minutes early you can store up extra heat that will cook the steak more rapidly.

Water for coffee, tea, or just dishwashing can be heated in a kettle or pot. To get the maximun efficiency from your solar cooker, use blackened utensils; however, just about any kind of utensil works satisfactorily. For variety try using a pressure cooker.

Because the sun moves across the sky, position of the reflector will be different

as the time passes. In the early morning or late afternoon it will be nearly vertical, while at noon you will have to place it practically flat on the ground. That's why we drill so many holes in the support rod. If you plan to boil beans or make stew, occasional adjustment of the reflector will be required to keep the hot spot where it will do the most good. The shadow from our pointer rod is the thing to watch. For the bacon and eggs, hot dogs, and even steak, one setting will usually do the trick.

After cooking the meal and washing the dishes, remove the grill from the aluminum tube and clean it, too. Then wipe off the reflector surface with a paper towel or damp cloth and that's all there is to the job of solar cooking.

Of course, solar stoves won't take the place of other kinds of cooking all the time. When the sun goes down you had better be through cooking, and on a rainy day the reflector is not much use except maybe to crawl under to keep dry! But properly used in clear weather it will amaze the most skeptical observer. Here are a few of the advantages of solar cooking.

As you discovered when you held you hand close to the focal point, there is no warming-up period with a solar stove - it is hot right away! By the time the fellow with the charcoal brazier gets a good bed of coals you will be doing the dishes. Besides he paid for his fuel while yours is free for the taking. And solar energy is available any place the sun shines - mountains, desert, beach, or your own back yard.

At first the reflection from your cooker might be bothersome, and a pair of sunglasses will be handy. After practicing a while you'll find out where to stand so there isn't any glare, and by then you will have noticed how nice it is not to have your eyes full of smoke. Solar cooking is cool cooking, too, because heat goes into the food on the grill and doesn't roast the person doing the cooking as well.

You won't need matches to get your cooker going, and there's no danger of setting anything on fire either. Lastly, there are no ashes or soot to contend with. And if someone complains about the lack of charcoal or hickory taste, provide him

with a bottle of liquid smoke.

Seriously, you will have a lot of fun cooking with sunshine. It's safe, it's clean, and it's free. Chances are you'll like it enough to want a portable cooker for the next camping trip. That way you won't be tied down to a fireplace and the bother that goes with it. So save up for a commercial folding cooker, or you might even put your ingenuity to work and make a version of the cardboard stove that is portable.