Heat Principles

3 Purposes of a solar cooker:

Cook food
Purify water
Sterilize instruments

3 Principles when creating a solar cooker:

Heat gain
Heat loss
Heat storage

Heat Gain

What is the greenhouse effect?

This effect results in the heating of enclosed spaces into which the sun shines through a transparent material such as glass or plastic. Visible light easily passes through the glass and is absorbed and reflected by materials within the enclosed space.

What type of heat transfer is illustrated by the greenhouse effect?

Heat Gain

Why is it important to have a dark metal absorber in your solar cooker?

The light energy that is absorbed by dark pots and the dark absorber plate underneath the pots is converted into longer wavelength heat energy and radiates from the interior materials. Most of this radiant energy, because it is of a longer wavelength, cannot pass back out through the glass and is therefore trapped within the enclosed space.

Why might you want to have your absorber plate slightly off the bottom of your cooker?

So you can avoid the conduction heat transfer that cools your cooker rather than raised the temperature.

How does glass orientation affect your solar cooker?

The more directly the glass faces the sun, the greater the solar heat gain. Although the glass is the same size on box 1 and box 2, more sun shines through the glass on box 2 because it faces the sun more directly. Note that box 2 also has more wall area through which to lose heat.

How can reflectors improve your solar cooker?

Single or multiple reflectors bounce additional sunlight through the glass and into the solar box. this additional input of solar energy results in higher cooker temperatures.

Heat Loss

How does conduction play a role in good solar cooker design?
It plays a role by being the handle of a metal pan that is on a stove becomes hot through the transfer of heat from the fire through the materials of a pan. In the same way, heat within a solar box is lost when it travels through the molecules of tin foil, glass, cardboard, air, and insulation, to the air outside of the box.

How does radiation play a role in good solar cooker design?
It plays a role by being things that are warm or hot. Fires, stoves, or pots and food within a solar box cooker, give off heat waves or radiate heat to their surroundings.
Why would you want to use foil on the side of the cooker?

What happens to the radiate heat given off by pots or pans in the cooker?
Most of the radiant heat given off by the warm pots within a solar box is reflected from the foil and glass back to the pots and bottom tray.

How does convection play a role in good solar cooker design?
It plays a role because they are molecules of air that move in and out of the box through cracks. Heated air molecules within a solar box escape, primarily through the cracks around the top lid, a side oven door opening, or construction imperfections.

What type of heat transfer explains the loss of heat through crack or holes in your cooker?
Convection

Material Requirements

Structural Materials:

Considering the short amount of time you have to build your cooker, what is structural material will you use to build the body of your cooker?
We would take 6 pieces of plexi-glass and create a cube, and we would put the dark metal plate at the bottom. We would also make a wood bottom piece to set it on so that there is no heat transferred into the ground. One of the plexi-glass faces would be attached with hinges so that we could open and close it to put food and water inside. This design would allow for the sun to come in at all angles.

What is a possible issue with dense structural materials, how will you deal with it?
The heat will not be able to come through and pasteurize the water like we need it to.

Insulation:

What can you use as insulators for your solar cooker and where will you use them?
Aluminum foil; this helps the inside to reach high temperatures.

How can you minimize the loss of heat through conduction when installing your insulation?
The insulator material on the outside can keep the heat inside and keep it from escaping to the outside.

Moisture Resistance:

Why is moisture resistance an issue?
When there's no moisture barrier is made on the outside of the box, the vapor from the food and water has to escape.
How does moisture escape the cookers?
It has gaps and cracks or it escape through box walls or the bottom.

Design Proportion and Operation:

What considerations should be taken for the size of the box?
It should be big enough for a common meal. It must be abled to be moved often. It must be able to hold as much cookware as possible.

What is the importance of solar collection area to box volume ratio?
The bigger, the oven, it needs to store more heat to be able to heat things up. The bigger the oven, the more heat gets lost, so you need to be sure that you also account for more heat.

How can you determine the solar collection to box volume ratio?

Everything else being equal, the greater the solar collection area of the box relative to the heat loss area of the box, the higher the cooking temperatures will be. Given two boxes that have solar collection areas of equal size and proportion, the one that is of less depth will be hotter because it has less heat loss area

area of collector/box volume

What is the role of reflectors?
Reflectors increase the sun beams that enter the cooker and pasteurize the water.