

Name \_\_\_\_\_ Date \_\_\_\_\_ Class \_\_\_\_\_

### Pizza Box Solar Oven: Student Worksheet

Let's put our knowledge of heat energy transfer to the test! Do you have what it takes to design a working solar oven? Can you use your understanding of heat and energy to harness the sun's radiation and cook food without using any other energy sources (no electricity or fuel)?

Define the following and state one example of each:

**Conduction** \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

**Example** \_\_\_\_\_  
\_\_\_\_\_

**Convection** \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

**Example** \_\_\_\_\_  
\_\_\_\_\_

**Radiation** \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

**Example** \_\_\_\_\_  
\_\_\_\_\_

## Procedure: How to Build a Pizza-Box Solar Oven

1. Use your ruler to draw a line on the top of the box that is two inches from the front side of the box that opens. Draw it along that entire side
2. Now use your ruler to draw a line that is one inch from each of the sides on the top of the box. When you are two inches from the back of the top of the box, stop the line.
3. Being very careful with your scissors, cut along these lines. You should be cutting a rectangle out of the top of the box, but only along three sides. Do not cut the rectangle out along the back side. It should be a flap that opens and closes; it is a window to let in your *solar radiation*.
4. Cover the inside of your pizza box with foil. The foil will reflect the *solar radiation* into the box. You will use white glue to glue the foil to the box. Do not use excessive amounts of glue. Please be conservative with our classroom supplies. Make sure that you press the foil flat into the box, especially on your window flap. The flatter it is, the better it will act like a mirror.
5. Cut out a rectangular piece of black butcher paper and glue it to the bottom of the pizza box, on top of the aluminum foil. Black will help absorb the heat so that the heat stays in the box and is not lost via *conduction*.
6. Fold your pizza box into a box shape by folding along the creases of the box. Because we do not want heat loss by *convection*, we will use duct tape to tape the edges of the pizza box shut so that air can not escape the box.
7. Tie or tape a piece of string to the back of the box. Then, punch a whole on the middle edge of the flap so that the string can be tied to the flap to keep it open.

**Question/ Purpose** \_\_\_\_\_

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**Hypothesis** (*Remember:* Room temperature is about 22°C & boiling point is 100°C.)

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**Materials**

- pizza box solar oven
- thermometer
- timer
- small cup of water

**Procedure**

1. Set up your pizza-box solar oven in the sun. Turn the box so that the opening is facing the sun. Then tilt the window until you can see the sun's light reflect into your box. Tie the window open at this distance.
2. Place the small cup of water in the oven and record the initial temperature of the water.
3. Cover your window opening with an acrylic sheet. Although this is plastic. You must still be careful not to break it or cut yourself.
4. Push the thermometer through a small hole on the edge of the box until the tip reaches the place where the sun shines through the window, but try not to let it touch the ground. Record the initial temperature inside the box right away.
5. Every 5 minutes, record the temperature inside the pizza-box solar oven. Leave the thermometer in place while you are waiting. You can pull the thermometer out slightly to look at the temperature if necessary, but not for long.
6. When you have finished all of the recordings, open the pizza box and quickly record the final temperature of the water.
7. You will now need to carry the materials back to the classroom. Close your pizza box after removing the water and thermometer. Leave these on the tray outside.

**Data**

Temperature Outside: \_\_\_\_\_ (Remember to always use degrees Celsius.)

Initial Water Temperature: \_\_\_\_\_

Final Water Temperature: \_\_\_\_\_

Time (minutes)	Temperature (°C)
0 minutes	
5 minutes	
10 minutes	
15 minutes	
20 minutes	
25 minutes	

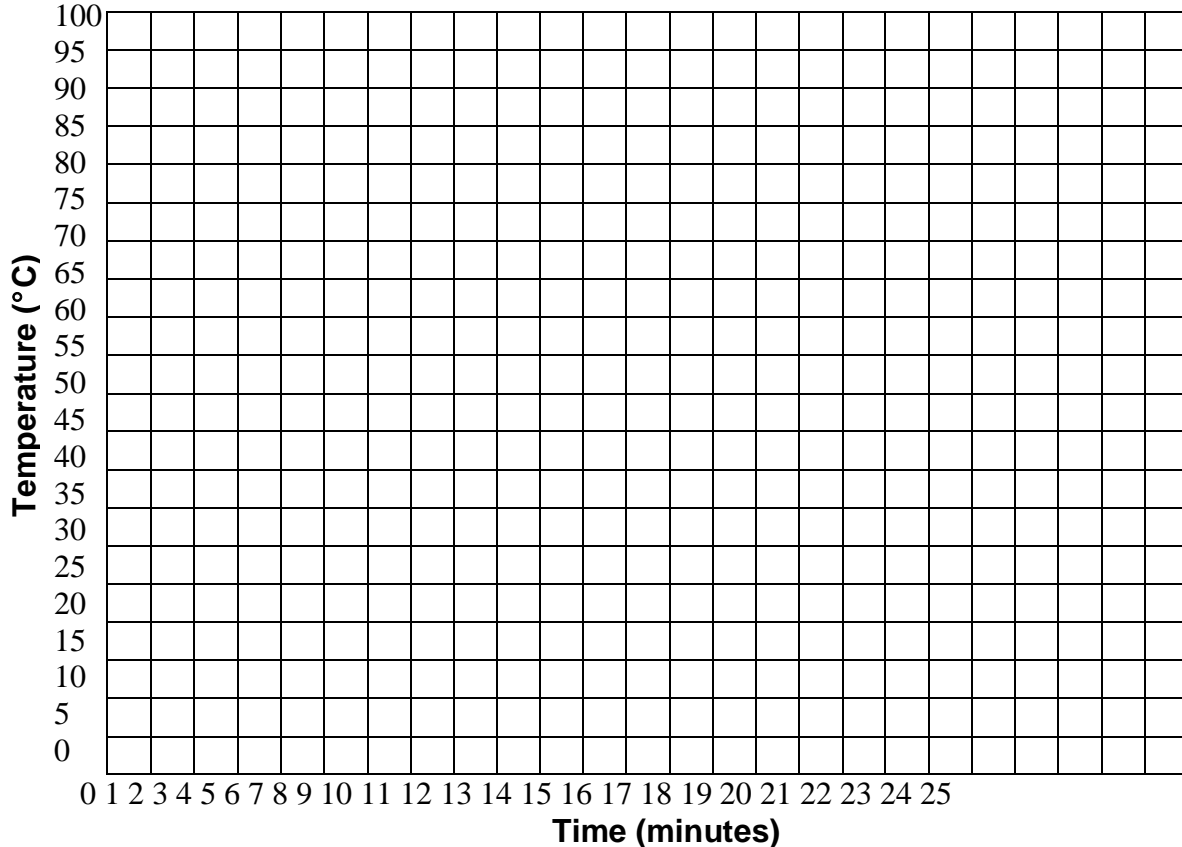
Final Oven Temperature: \_\_\_\_\_

**Analysis**

8. What is the final oven temperature in degrees Fahrenheit? \_\_\_\_\_

**Use this equation: °F = (9/5 × °C) + 32**

9. Make a line graph that shows how the temperature changed over time.



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**Conclusion** \_\_\_\_\_

Name 3 ways that you think you may have lost heat from your pizza-box solar oven.

1. \_\_\_\_\_

Was this conduction, convection or radiation? \_\_\_\_\_

How might you be able to fix this problem to make your oven better? \_\_\_\_\_

2. \_\_\_\_\_

Was this conduction, convection or radiation? \_\_\_\_\_

How might you be able to fix this problem to make your oven better? \_\_\_\_\_

3. \_\_\_\_\_

Was this conduction, convection or radiation? \_\_\_\_\_

How might you be able to fix this problem to make your oven better? \_\_\_\_\_