# Activity 3: Create a TechXcite Thermos

**Name:** _____

**Date:** _____

### Engineering Design Problem

Your engineering design challenge today is to create a TechXcite Thermos to test how well insulation works to keep heat in an aluminum soda can.

### Design Specifications and Constraints

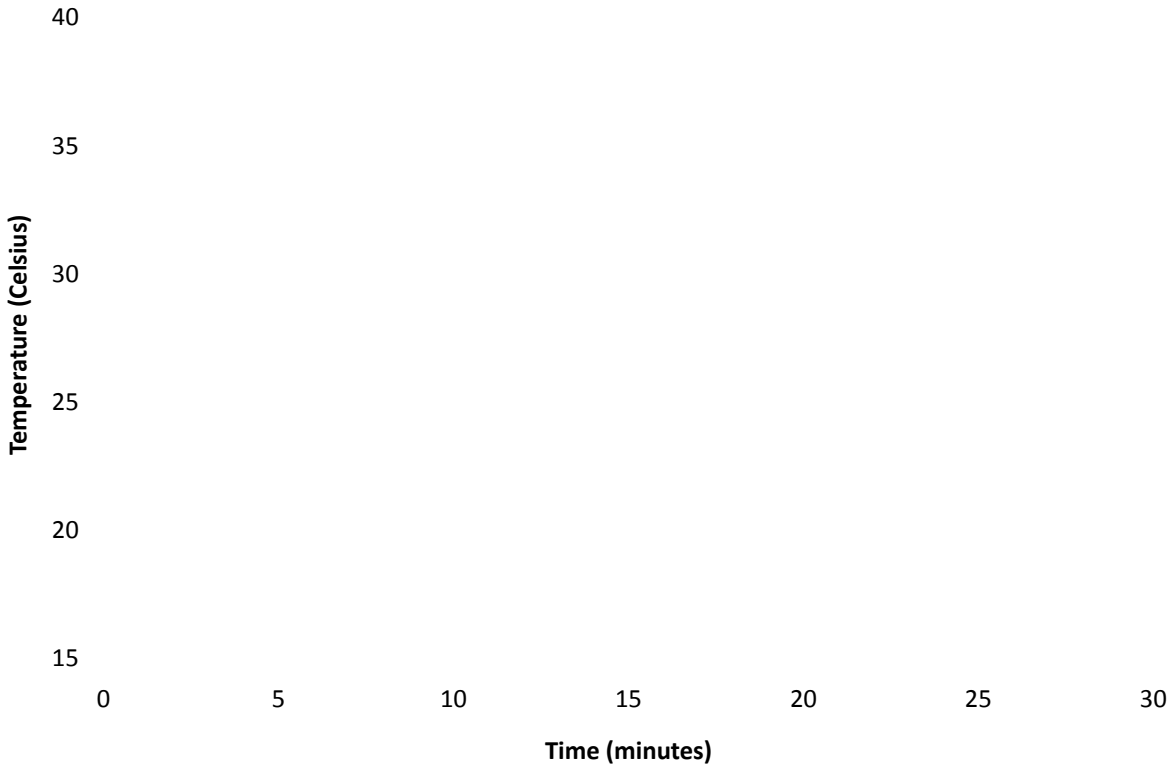
- Only use materials provided by your instructor
- Thermometer must be inside the can and easy to read
- Must not spill water when inserting the can in the thermos
- Must have a method to remove the can from your thermos and replace it with another can

**Draw or describe your design below:**

In the table below, take measurements every 5 minutes for half an hour to determine how well the thermos keeps the water in the can warm.

| Time (mins) | Temperature of Can with Thermos (°C) | Temperature of Can w/o Thermos (°C) |
|---|---|---|
| 0 | | |
| 5 | | |
| 10 | | |
| 15 | | |
| 20 | | |
| 25 | | |
| 30 | | |

## Graph of Can Cooling over Time



# Activity 4: Building a Solar Oven

**Name:** _____

**Date:** _____

### Engineering Design Problem

Use what you have learned and the materials provided to build a solar oven that can reach as high a temperature as possible.

### Design Specifications and Constraints

- The oven's interior must be big enough to hold your cooking container and a thermometer. You will need room to bake at least a few cookies on a piece of foil or heat water in a small cup. To meet these requirements, the bottom must be at least 6"x6"and the walls must be at least 4" tall.
- The oven must open and close to allow you to put in and take out food and to put a thermometer in place.
- The oven bag will be used to make a transparent window. You must find a way to attach it to your oven to create a lid.

### Design Strategies

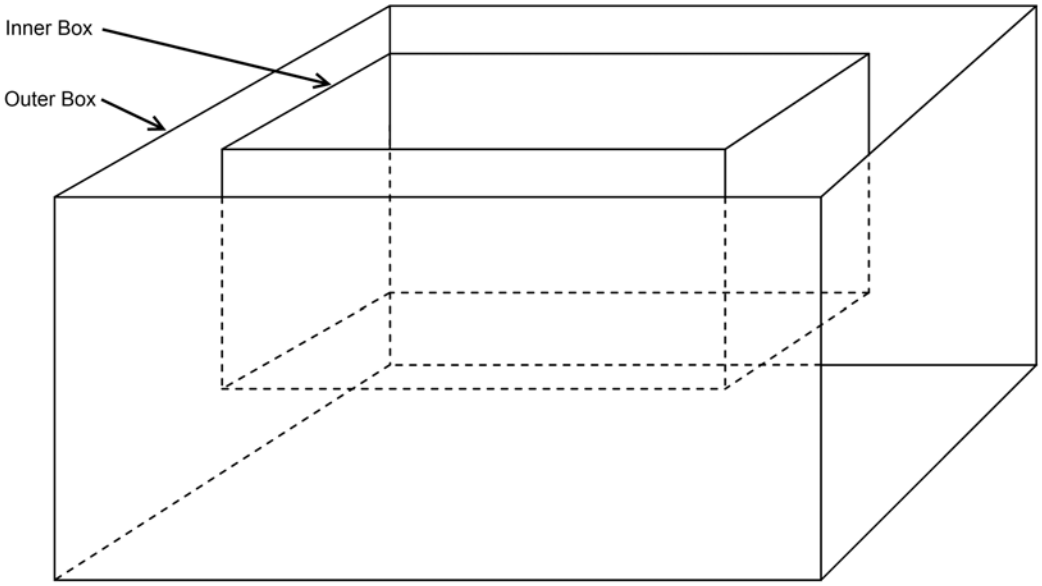
*Reduce heat loss through conduction and convection*

- Place insulating material in the space between the inner and outer walls to reduce heat loss. Use the results from your experiments in Activity 3 as a guide. If you have limited amounts of the best insulation materials, be sure to use them to your advantage.
- Construct a secure lid to keep heat from escaping. Think of the car analogy. If we open the door of the heated car, hot air will flow out and the temperature inside drops. In the case of our ovens, we want to keep the hot air inside. Though you must be able to open and close the lid, you want it to seal as tight as possible when shut.

*Increase heat-gain from solar radiation*

- Experiment with making portions of the interior black using construction paper, tape, or paint (if available). The color of the interior surfaces affects the amount of energy transferred from radiant energy (sunlight) to heat.
- Devise a way to move the oven during cooking so that the sun is always directed into the oven. You might use blocks to prop the oven up to point it at the sun.

- Use dark-colored containers for cooking. As you already learned, they will absorb more heat than lighter-colored containers.
- Reflect sunlight toward the cooking area. You can place objects outside the oven to catch and reflect light toward the opening of the oven. You must decide how to build and place the reflectors to direct as much light as possible.


Basics solar oven design: a box within a box

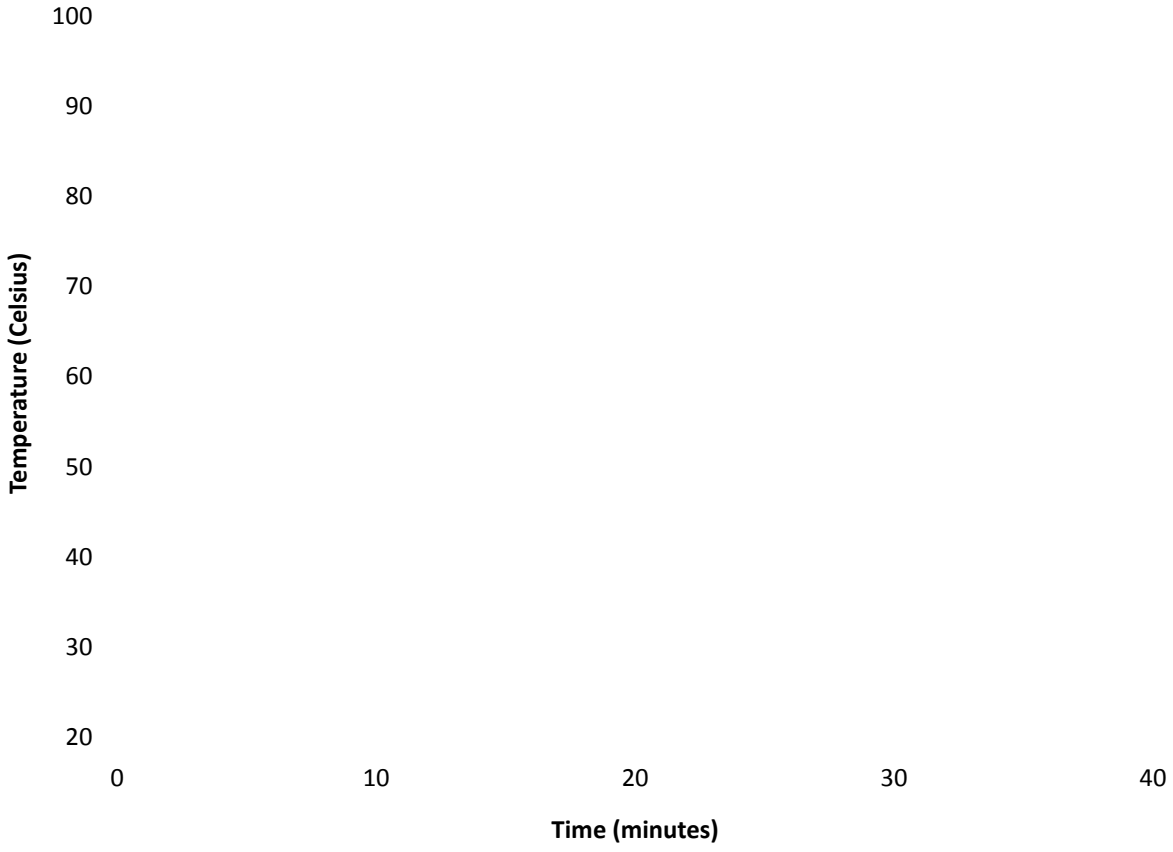
**Testing & Analysis**

To test your oven, place it outside on a sunny day. Measure the air temperature inside the oven and record it on the next page. Continue measuring the temperature every 10 minutes and graph your results. After the first 30 minutes, you may take measurements less often. Compile your data with the rest of the class so that everyone can observe the different heating curves the other groups obtained.

| | |
|---|---|
| Was it cloudy, partly cloudy or sunny when you tested your solar oven? | |
| What was the temperature outdoors during your test? | |
| What time of day did you perform your test? | |
| What temperature did your solar oven reach in 30 minutes? | |

| Time (mins) | Group 1 | Group 2 | Group 3 | Group 4 | Group 5 | Group 6 |
|---|---|---|---|---|---|---|
| 0 | | | | | | |
| 10 | | | | | | |
| 20 | | | | | | |
| 30 | | | | | | |
| 40 | | | | | | |

## Graph of Solar Oven Temperatures



Draw a diagram of your solar oven below. Indicate where there is heat transfer due to radiation and indicate where there is heat transfer due to conduction.

Explain how a solar oven works.

What aspects of your solar oven design worked well?