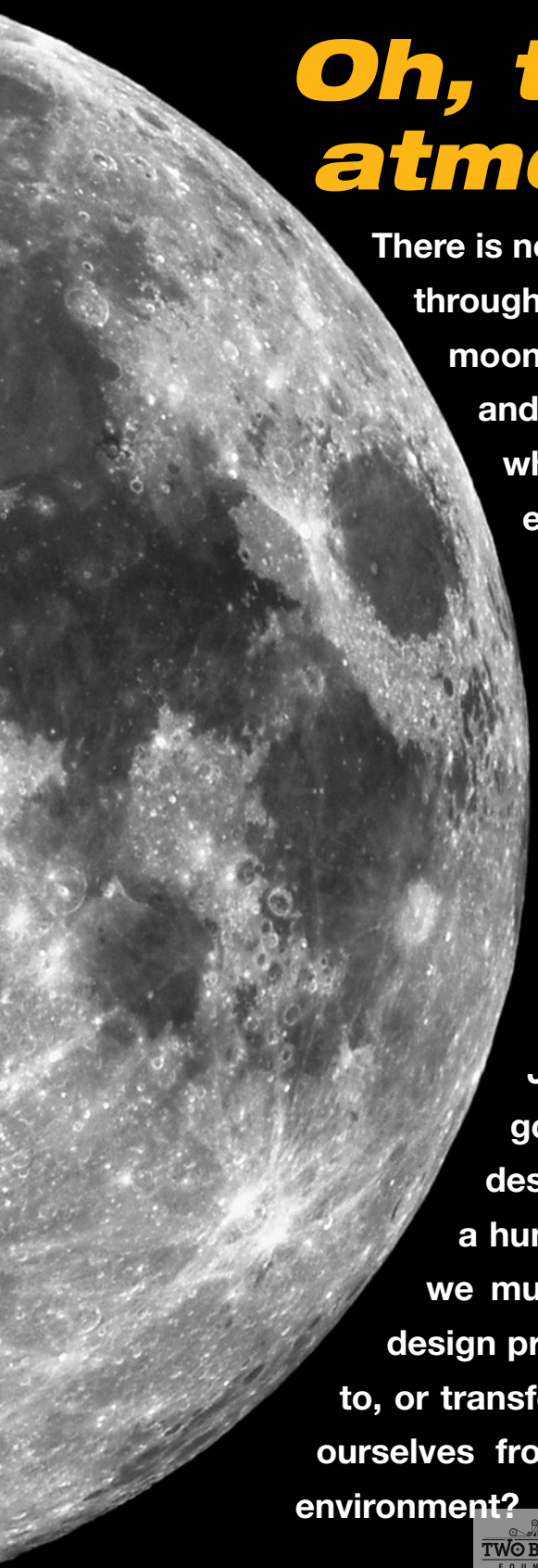

Oh, to not have an atmosphere!

There is no atmosphere on the Moon, so temperatures fluctuate through a very wide range. In the shadowed areas of the moon, the temperature can be as low as -180°C (or -300°F), and in the sunlit areas, it is about 100°C (or 212°F), which is the boiling point for water! These are serious extremes for human beings! Furthermore, there are spots on the Moon that are permanently exposed to the Sun, and others permanently in shadow. It is in the permanently shadowed areas of some craters that scientists believe water ice may exist.

Protecting Ourselves

Anyone living on the Moon - even for a short while - will have to deal with this temperature variation and be protected properly from its damaging effects. Just think about the number of layers you wear when going outside on a very cold winter's day. The goal in designing a space suit is to create protective layers to keep a human body at a fairly constant temperature. Therefore, we must understand how heat moves. Engineers need to design protective wear to **prevent heat** from being transferred to, or transferred away, from our bodies. How could we **insulate** ourselves from the wide variations of temperature in the lunar environment?

THE CHALLENGE:

Your mission is to design a "Lunar Thermos" – a protective insulator for a cup of hot and a cup of cold water. You must also conduct an experiment to compare your insulated cups to unprotected cups set up by your teacher. The design constraints are:

1. ***Use any combination of materials available to you to create a protective insulating layer to keep 100 ml of hot water, and 100 ml of cold water, at a relatively constant temperature.***
2. ***Your "Lunar Thermos" temperatures should change by no more than 3 °C over 5 minutes.***
3. ***You must be able to graph your results (optional).***

DESIGN challenge

To design an insulator for a cup of hot water and a cup of cold water to maintain water temperature relatively constant. To apply the understanding of how things get warmer and cooler heat transfer.

Design a Lunar Thermos
Student page

lunar thermos

ASK IMAGINE &PLAN

What questions do you have about today's challenge?

What is heat energy transfer? Simply put, it is the method of things warming up or cooling down. We can determine how much heat is transferred, by measuring the change in temperature. Take a few minutes and find the definitions of these two words:

HEAT _____

_____

TEMPERATURE _____

_____

Draw a picture of a warm human standing on the Moon in the cold, lunar night. Label what is warm and cold. Use arrows to show which way the heat moves.

Now imagine that the sun comes up, and the human is standing on the hot lunar surface. Re-draw the picture and label what is warm, cold, and which way the heat moves.

Draw and label the materials you will use to build your Lunar Thermos.

Approved by: _____

Experiment & Record

1. Collect necessary materials and create your Lunar Thermos for each cup.
2. Record the temperature of the room: _____ °C
3. Using a graduated cylinder, collect 100 mL of cold tap water and pour it into one plastic cup. Repeat for hot water (from the tap).
4. Record the temperature for each cup of water every 30 seconds for 5 minutes total. Record your results on the next page for Trial 1.

Lunar Thermos Data Table

Time Min:sec	Cold Water Cup (°C)		Hot Water Cup (°C)	
	Trial 1	Trial 2	Trial 1	Trial 2
0:00				
0:30				
1:00				
1:30				
2:00				
2:30				
3:00				
3:30				
4:00				
4:30				
5:00				

5. Improve your design by trying another combination of materials and repeat the experiment. Record your results for Trial 2.

DESIGN challenge

To design an insulator for a cup of hot water and a cup of cold water to maintain water temperature relatively constant. To apply the understanding of how things get warmer and cooler heat transfer.

Graph the results from your experiment, using the data from either Trial 1 or Trial 2. Time is the independent variable in this experiment. You, as the experimenter, decided when to take temperature readings. The independent variable is plotted on the x-axis. The temperature of the water is the dependent variable in this experiment. The temperature of the water depends on the time it was measured. The dependent variable is plotted on the y-axis. Label the y-axis below and plot your data using dots. Connect your dots to make a line. Draw two lines in two different colors to distinguish the data from each cup.