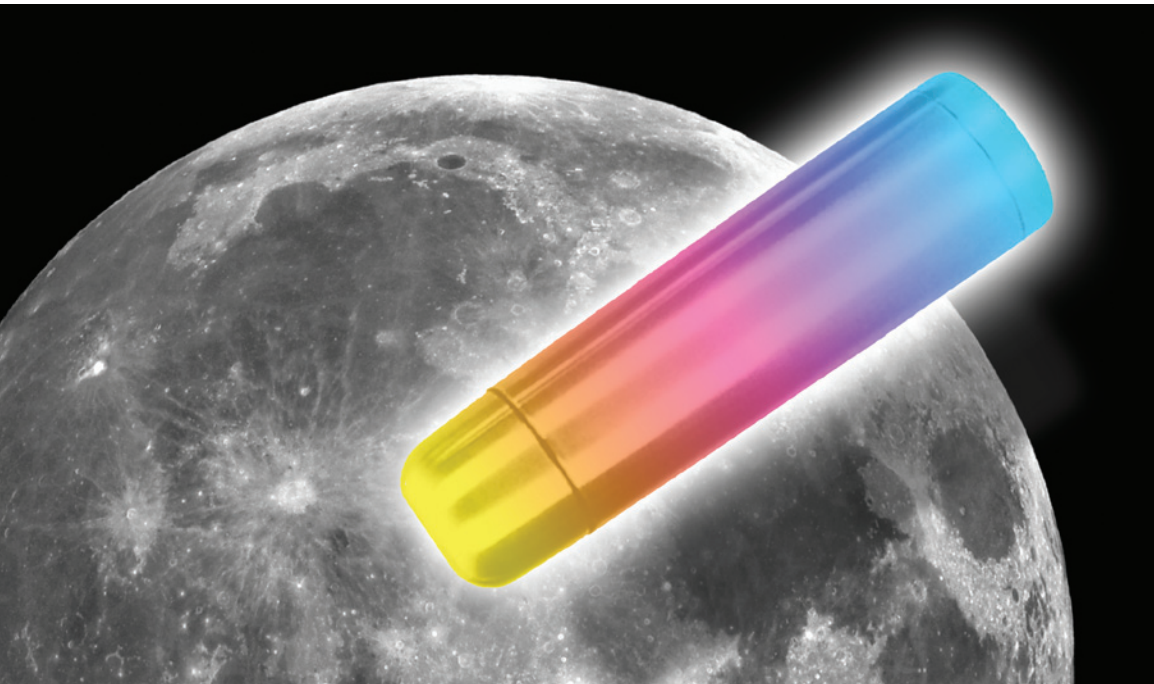


Design a Lunar Thermos

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.



OBJECTIVE

To demonstrate an understanding of the Engineering Design Process while utilizing each stage to successfully complete a team challenge.

PROCESS SKILLS

Experimental design, measuring, graphing and data analysis

MATERIALS

Glow sticks (2)

Thermometers

Stopwatches

Graduated cylinders

Plastic cups

Insulating materials

(e.g. bubble wrap, paper, cloth, sand, water, foil, Styrofoam, etc)

STUDENT PAGES

Design Challenge

Ask, Imagine and Plan

Experiment and Record

PRE-ACTIVITY SET-UP

While the students are using the EDP to create an insulator, they will also be conducting a scientific experiment that requires a control. While the students test their cups, place a cup of hot water and a cup of cold water at the front of the room, un-insulated, each holding a thermometer. Set a timer for every 30 seconds and record the data to share with the students so they may compare their data.

Please note: This activity may require two 60-90 minute sessions to complete.

MOTIVATE

- Ever wonder what is involved in designing today's spacesuits? Check out this interactive site to learn about NASA's spacesuits:

www.nasa.gov/audience/foreducators/spacesuits/home/clickable_suit.html

SET THE STAGE:

ASKIMAGINE & PLAN

- Share the *Design Challenge* with the students
- Let students pretend to be molecules. First have them stand still and close together. Then have the students wiggle and then walk and move around to demonstrate more heat energy entering the system. Have them move faster and jump up and down as even more energy enters the system. Then have the students stop to notice where they are standing. (Note: They should be much farther apart and should feel much warmer than they were originally.)
- Place a glow stick in a clear cup of hot water and a clear cup of cold water, then turn off the lights. Using the knowledge they just acquired from the earlier activity, ask the students to select the glow stick with more molecular movement.

CREATE

- Challenge the students to devise an insulation system to keep water at a constant temperature.

EXPERIMENT

- Have students follow the directions on the *Experiment and Record* worksheet to complete their experiment.
- Students should graph the temperature results as a line graph and analyze. Building a graph is not a math standard often taught in 3rd grade, depending on your state. It is your discretion of whether or not to have students graph their data. Feel free to share the graphing video with your students to demonstrate how to build a graph:

<http://svs.gsfc.nasa.gov/goto?10515>

IMPROVE

- Have students design other combinations of materials to decrease any temperature fluctuation from their first design.

CHALLENGE CLOSURE

Engage the students in the following questions:

- *How did the temperature of the hot water change? Cold water?*
- *How does your experiment's data compare to the control experiment your teacher conducted at the front of the room?*

PREVIEWING NEXT WEEK

During this session, you explored designing insulation to reduce temperature changes, much like protecting humans from the extreme temperature swings on the Moon's surface. What if you needed to capture heat energy instead? Why would you need to capture heat energy if we wanted to live on the Moon?

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Teacher page