

Activity Title: It's Either Very Hot or Very Cold Up There!

Activity Objective(s): In this activity, and the follow-up activity next week, teams will design and conduct experiments that will help them understand the basic principles of thermal transfer – how things warm up and cool down. They will carefully gather data and then analyze that data in order to make generalizations about the factors that affect how things get warmer and cooler.



Graphic courtesy NASA.

Grade Levels: K - 2

Lesson Duration: One 60 min session

Process Skills: Scientific inquiry, measuring, and data analysis.

Materials and Tools (per group of three students):

- Thermometers
- 2 plastic cups
- 2 glow sticks
- Hot and cold tap water

Club Worksheets: (Make copies for each student to put in binder)

1. Imagine
2. Data Table
3. Challenge Closure / Summary
4. Fun With Engineering at Home

Club Facilitator or Teacher Notes by Stage: *(Based on those running 60-minute Clubs)*

Stage 1: Set the Stage (Approx 10 minutes)

Explain to the students that there is no atmosphere on the Moon, so temperatures fluctuate through a wide range. In the shadowed areas the temperature is -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!

Additionally, because of the unusual rotation of the Moon, there are surfaces permanently exposed to the Sun, and surfaces permanently in shadow. It is in the permanently shadowed areas of some craters that the possible existence of ice has been speculated by some scientists.

Anyone living on the Moon, even for a short while, will have to deal with this temperature variation, and be properly protected from damaging effects. Thus we must understand how thermal energy is transferred, and, for our concerns, how we can prevent thermal energy from being transferred (to or from our bodies): in other words, how can we insulate ourselves from the wide variations of temperature in the lunar environment?

Due to the complexity of the concepts included in this lesson, the teacher may have to include a mini-lesson on molecules. Lead a discussion of the following vocabulary words and then complete the activity below:

- **Heat** = The energy that an object has due to movement of molecules.
- **Molecule** = Small particles that make up living and non-living things.
- **Temperature** = A measure of the amount of heat or thermal energy.

Stage 2: IMAGINE (Approx 10 min.)

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 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 and notice where they are. They should be much farther apart and should feel much warmer than they were originally.

- In this lesson, participants will become familiar with using and recording information taken with a thermometer. They will also learn about the relationship between heat and energy.
- Molecules with a lot of energy move faster than molecules with a smaller amount of energy. In this activity, participants will use heat as an energy source to illustrate this phenomenon. When a glowstick is placed in hot water, the molecules inside the glowstick move faster, causing it to shine

brightly. When the glowstick is placed in ice water, the molecules inside the glowstick move slower. This results in less illumination.

Stage 3: ACT – The Experiment (Approx 25 min)

- Break the students into teams of three and distribute the **Challenge** worksheet.
- Explain that the students will be completing an experiment that will help us to understand how thermal energy (heat) flows through substances, such as water.
- Allow students to gather materials and begin experiment as they work through the Challenge worksheet.

Stage 4: Analysis/Challenge Closure (Approx 10 min.)

- Hand out the Challenge Closure / Summary Sheets (please collect one per team and save in a folder for NASA).
- Students will work in teams to answer questions based on their experience with this experiment. Questions should be used to evaluate present levels of understanding for the concepts presented.

Stage 5: Previewing Next Week (Approx 5 min.)

- The Moon is a very harsh environment. There is no atmosphere to protect astronauts and their equipment from solar radiation and the extreme temperature swings between night and day. Next week, we will begin to find ways to protect astronauts from those extreme temperature changes by experimenting with insulation.

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1. ASK:

Goal: Conduct an experiment to learn about the relationship between temperature and energy.

Materials:

- Thermometer (must use the Celsius scale)
- Small plastic cups
- Hot and cold water from a tap
- 2 glowsticks

2. IMAGINE:

Draw a picture of what you think the glowstick will look like when it is placed in cold water.

Draw a picture of what you think the glowstick will look like when it is placed in hot water.

3. TEST:

Challenge Worksheet

Your group will be completing an experiment to understand the relationship between energy (heating and cooling) and temperature.

Follow the steps to complete the experiment:

- Assign each group member a job for this experiment: Materials Manager, Recorder, and Thermometer Analyst.
- Have the Materials Manager collect the necessary materials for the experiment.
- Label the outsides of each plastic cup so you know which cup is the hot water and which is the cold water.
- Remove a glowstick from its wrapper. Bend the glowstick until you hear a snap to activate the glowstick.
- Place hot water in one cup and cold water in the second cup.
- Start with the cup containing the hot water. Test the temperature of the water by placing the thermometer in the water. Record the temperature. Next, place the glowstick in the hot water and record at least one observation about the glowstick in the chart below.
- Test the cup containing the ice water. Place the thermometer in the water and record the temperature. Now place the glowstick in the water. Record the temperature and at least one observation about the glowstick in the chart below.

Cup	Temperature (C)	Glowstick Observation(s)
Hot Water		
Cold Water		

4. CHALLENGE CLOSURE

Draw a picture of how the glowstick appeared in the cold water from the experiment.

Draw a picture of how the glowstick appeared in the hot water from the experiment.

Fill in the blanks with a word that correctly completes the sentences.

Warm water caused the molecules in the glowstick to move _____.

Cold water caused the molecules in the glowstick to move _____.

Team Name: _____

Fun with Engineering at Home

Activity 9: It's Either Very Hot or Very Cold Up There!

Today we designed and conducted experiments with energy flowing into or out of containers of water. We chose water to experiment with because it is such a large part of the human body, and if we try to inhabit the Moon we will have to pay close attention to keeping the human body safe from the extremes of temperature on the surface of the Moon.

- **Home Challenge:** During this week talk with your parents and friends about all the ways we keep the human body safe from extremes of temperature on the Earth (even though the range of variation is not nearly as great as that found on the Moon).

- List four ways we do something with our bodies to prevent temperature extremes from affecting them (two related heat; two related to cold):

- _____
- _____
- _____
- _____

- Now list four things we do to change the environment we live in so that the environment does not harmfully affect us because of temperature extremes (two related to heat; two related to cold):

- _____
- _____
- _____
- _____

HAVE FUN!!