TEACHERS GUIDE

ICE MELTING BLOCK

ITEM # 3228-00

This lesson will introduce students to the principles of thermal conductivity and heat transfer using an ice melting block experiment. Students will learn how different materials conduct heat differently, and how this affects their ability to transfer heat to other materials, such as ice. The experiment will help students to develop their critical thinking and problem-solving skills, as well as their ability to analyze and interpret data.

Materials

- Ice Melting Blocks
- 2 rubber rings
- Ice cubes
- Stopwatch or timer
- Notebook and pen/pencil
- Various materials, such as metal, plastic, wood, or glass
- Ice cubes
- Stopwatch or timer

Goals & Objectives

See page 8 for Next Generation Science Standards (NGSS)

INTRODUCTION

The ice melting block experiment teaches students about thermal conductivity and heat transfer by comparing the melting times of ice cubes on two different blocks. Through this hands-on activity, students can develop critical thinking skills and gain a deeper understanding of how materials conduct heat differently.

HISTORY

While the specific origins of the ice melting block experiment are unclear, the concept of thermal conductivity and heat transfer has been studied for centuries. Ancient Greek philosophers such as Empedocles and Aristotle made observations about heat transfer, and the study of thermodynamics began to emerge in the 19th century with the development of the steam engine. In the 20th century, advancements in technology allowed for more precise measurements and experiments, and the ice melting block experiment became a popular tool for demonstrating thermal conductivity and heat transfer in physics and materials science classes. Today, the experiment continues to be used in classrooms around the world to teach students about the principles of heat transfer and the properties of different materials.

How It Works

The ice melting block experiment works by comparing the thermal conductivity of two different materials. Because thermal conductivity is a measure of how well a material conducts heat, and it can be affected by factors such as the type of material, its thickness, and its temperature.

In the experiment, identical ice cubes are placed on top of the two different blocks. One block is made of a material with high thermal conductivity, while the other block is made of a material with low thermal conductivity.

Because the block with higher thermal conductivity conducts heat more efficiently, it will transfer heat more quickly to the ice cube, causing it to melt more rapidly. The block with lower thermal conductivity conducts heat less efficiently, and will transfer heat more slowly to the ice cube, causing it to melt more slowly.

By measuring the time it takes for the ice cubes to melt on each block, students can compare the thermal conductivity of the two materials and gain a better understanding of how different materials conduct heat. Through this hands-on experiment, students can develop their critical thinking skills and deepen their understanding of the principles of heat transfer and thermal conductivity.

ACTIVITIES

1. Introduce the concepts of thermal conductivity and heat transfer to the students. Show the two blocks to the students and explain that each block has different thermal conductivity. Have the students predict which block they think will melt the ice cubes more quickly. They will most likely assume that the block that feels “cooler,” to the touch will prevent the ice cubes from melting for a longer amount of time.

2. Place identical ice cubes on each block. Start the timer and record the time it takes for the ice cubes to melt on each block.

3. Discuss the results with the students. Ask them to explain why one block melted the ice cubes more quickly than the other.

4. Challenge the students to repeat the experiment using different materials, such as plastic or wood.

5. Have the students record their observations and data in a notebook, and discuss their findings with the class.

Assessment:

Have the students write a report summarizing their observations and conclusions from the experiment.

Assign a research project on thermal conductivity and its practical applications in different industries.

Extensions:

Challenge the students to design their own experiments to test the thermal conductivity of different materials.

Use the experiment as a springboard for discussions on energy transfer and conservation, as well as the environmental impacts of different materials used in energy production.

Have the students research how thermal conductivity is used in various industries, such as construction and manufacturing, and present their findings to the class.

***Note**

It is always wise to DO an experiment ahead of time to be able to best present it to the class.

ACTIVITIES 2

Design Your Own Ice Melting Block

Objective:
To design and test an ice melting block using different materials.

Materials:
Various materials, such as metal, plastic, wood, or glass

Ice cubes

Stopwatch or timer

Notebook and pen/pencil

Procedure:

1. Introduce the concept of thermal conductivity and explain how it affects the ability of materials to transfer heat.
2. Have the students research and brainstorm different materials that could be used to create an ice melting block.
3. Challenge the students to design their own ice melting blocks using the materials they have chosen. Encourage them to consider factors such as size, shape, and thickness.
4. Have the students predict which block they think will melt the ice cubes more quickly.
5. Place identical ice cubes on each block.
6. Start the timer and record the time it takes for the ice cubes to melt on each block.
7. Have the students record their observations and data in a notebook.
8. Discuss the results with the students. Ask them to explain why certain materials worked better than others.

Assessment:

Have the students write a report on their design process and the results of their experiment.

Assign a research project on the properties of different materials and how they affect thermal conductivity.

Extensions:

Have the students modify their ice melting blocks and repeat the experiment to test their improvements.

Use the experiment as a springboard for discussions on the properties of materials and their applications in different industries.

DISCUSSION

Additional Discussion and Real Life Applications

1. What is thermal conductivity, and why is it important in everyday life?
2. Why does one block melt the ice faster than the other?
3. How do different materials affect heat transfer?
4. Before starting the experiment, which block do you think will melt the ice faster? Why?
5. Can you think of real-life examples where materials with high or low thermal conductivity are used?
6. How does this experiment relate to cooking, building materials, or even clothing choices in different weather?
7. How could you modify the experiment to test other variables, like block size or initial temperature?

GLOSSARY

Thermal Conductivity – The ability of a material to transfer heat. Materials with high thermal conductivity (like metal) transfer heat quickly, while those with low conductivity (like wood) transfer heat slowly.

Heat Transfer – The movement of heat from one object or substance to another. Heat can be transferred through conduction, convection, or radiation.

Conduction – The process by which heat moves through a material without the material itself moving. Metals conduct heat well, while materials like plastic and wood do not.

Insulator – A material that does not conduct heat well, slowing down heat transfer. Examples include wood, plastic, and rubber

Conductor – A material that allows heat to pass through it easily. Examples include metals like copper and aluminum.

RESOURCES

Melting Ice Experiment – NASA
https://www.jpl.nasa.gov/edu/resources/lesson-plan/melting-ice-experiment/

Ice Melting Blocks Experiment Manual –Andrews University
https://www.andrews.edu/services/physicsenterprises/manuals/melt-manual.pdf

Melting Ice – Student Sheet – Nuffield Foundation
https://www.nuffieldfoundation.org/sites/default/files/files/Melting%20ice%20-%20merged%20PDF.pdf

Thermal Conductivity – Energy Education
https://energyeducation.ca/encyclopedia/Thermal_conductivity

Ice Melting Blocks Teacher Lesson Plan – Ohio Energy Project
https://ohioenergy.org/wp-content/uploads/2015/09/4-Thermal-Teacher-Ice-Melting.docx

Rates of Heat Transfer – The Physics Classroom
https://www.physicsclassroom.com/class/thermalP/u18l1f.cfm

Dramatic Demonstration of Thermal Conductivity and Specific Heat Capacity – TeachChemistry.org
https://teachchemistry.org/classroom-resources/dramatic-demonstration-of-thermal-conductivity

Thermal Conductivity - STEM Learning
https://www.stem.org.uk/resources/elibrary/resource/26745/thermal-conductivity

Changing State—Melting – American Chemical Society
https://www.acs.org/middleschoolchemistry/lessonplans/chapter2/lesson5.html

Thermal Conductivity – Khan Academy
https://www.khanacademy.org/science/physics/thermodynamics/specific-heat-and-heat-transfer/a/what-is-thermal-conductivity

Next Generation Science Standards

Students who demonstrate understanding can:

2-PS1-1: Plan and conduct an investigation to describe and classify different kinds of materials by their observable properties

4-PS3-2: Make observations to provide evidence that energy can be transferred from place to place by heat currents

MS-PS1-4: Develop a model that predicts and describes changes in particle motion, temperature, and state of a pure substance when thermal energy is added or removed

MS-PS3-3: Apply scientific principles to design, construct, and test a device that either minimizes or maximizes thermal energy transfer

MS-PS3-4: Plan an investigation to determine the relationships among the energy transferred, the type of matter, the mass, and the change in the average kinetic energy of the particles as measured by the temperature of the sample

Standards Key

K = Kindergarten
3 = 3rd Grade
(numbered by grade)
MS = Middle School
HS = High School
PS = Physical Science
LS = Life Science
ES = Earth Science

HS-PS3-4: Plan and conduct an investigation to provide evidence that the transfer of thermal energy when two components of different temperature are combined within a closed system results in a more uniform energy distribution among the components in the system (second law of thermodynamics).