MISSION POSSIBLE

IMAGINE. DESIGN. CREATE.

MISSION : Keep It Cool

Your mission is to build a cooler that will keep an ice cube from melting in the sun!

WHAT YOU'LL NEED

- **Ice cubes (at least two)**
- **Recycled material from around your house (paper, cloth, food containers, aluminum foil or anything else you think might help keep the ice cube cold)**
- **Tape (scotch tape or masking tape)**
- **A timer**
- **Optional: pencil, pen, crayon, or marker plus paper to draw on**

LET'S READ

Find a comfortable spot and read! Here are some ideas to get you started:

- *States of Matter: A Question and Answer Book* **by Fiona Bayrock**
- **I***ce to Steam: Changing States of Matter* **by Penny Johnson**
- *The Magic School Bus in the Arctic: A Book About Heat* **by Anne Schreiber**
- *DK Eyewitness: Matter* **by Christopher Cooper**

You can download digital copies of these books for free from openlibrary.org. Here is how!

1. **Go to openlibrary.org.**
2. **Click the blue "sign up" button on the top right to create a free account. You will be sent a confirmation email.**
3. **Sign in.**
4. **Type the book title and author into the search bar.**
5. **Find your book and click the blue "borrow" button.**
6. **Don't forget to return your book when you are finished reading it!**

Sam Noble Home | STEM Activities

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Get Started:

1) Pick the area where you are going to work (in the kitchen, on the driveway, etc.) You will also need a space outside with direct sunlight.
2) Gather the supplies and one ice cube.
3) Place the ice cube in the sun without anything to help keep it frozen and wait for five minutes. What happened?
4) Look at the supplies you collected:

THINK!

- Why do ice cubes melt in the sun?
- How can you use the supplies to help keep the ice cube from melting?
- Will you need any other materials?
- Optional: Draw what you want your cooler to look like!

5) Build it!
6) Once you have built your cooler, place an ice cube in it.
7) Set the cooler in the sun for five minutes, and then check the ice cube.

WHAT HAPPENED?

- Did the ice cube stay frozen?
- Did the ice cube melt a bit, but not completely?
- Did the ice cube melt completely?
- Did your cooler work like you thought it would?

8) Try again! Just because your idea didn't work the first time, doesn't mean you should give up. Think about how you can change your idea to build the cooler in a different way so it will keep the ice cube frozen. Be creative and try as many times as you want. Ask a partner for ideas if you've tried all of yours. (If you need some hints, check out the next page.)

When you're done, share what you did with someone!

TELL THEM

- Did it work on the first try?
- How did you change it to keep the ice cube frozen?
- How many ideas did you try?
- What was hard about the challenge?
- If they wanted to build a cooler like you, what should they do?

BONUS CHALLENGE

Now that you've built a cooler, see if you can:

- Design one that will keep an ice cube frozen for longer (try 10 or even 20 minutes.)
- Use a kitchen scale, measuring cups or spoons to measure exactly how much the ice cube melts each time.
- Challenge a partner to build a cooler using the same materials (example: everyone has 30 minutes to build a cooler that will be tested for two minutes.)

Engineers do more than build tall buildings or design complicated machines. Many engineers work to find solutions to the problems people have every day. Refrigerators, freezers and coolers are all designed by engineers who work to figure out how to keep the temperature inside cooler than the temperature outside, and that can be quite a challenge! The temperature of an area or an object is determined by the environment around it. The heat (the type of energy that is measured by temperature) in an environment tries to spread out evenly to everything in that space. This process, called heat transfer, is why the ice cube melted when it was placed into a warmer environment (the sun). There was more heat in the environment than in the ice cube, so the heat transferred to the cube to balance out the energy.

So how do we stop an ice cube from melting in the sun? We need to stop the transfer of heat! Insulators and reflectors are types of material that stop the transfer of heat, though they do it in different ways. Insulators are materials that don't allow heat to flow through them, while reflectors are materials that reflect heat back towards its source without absorbing it. We put insulation and reflecting materials in or on buildings, cars and even clothing to help keep the temperature inside what we want it to be. Which of these did you use in your cooler?

HELPFUL WORDS

Freeze (frozen): when a substance changes from a liquid to a solid
Gas: a substance that has no fixed shape or volume
Heat: energy that is measured or altered by temperature
Heat transfer: the flow of heat energy from a warm object to a cooler object
Insulation: something that slows down the transfer of heat
Liquid: a substance that doesn't have a fixed shape, but always has the same volume
Melt: when a substance changes from a solid to a liquid
Reflection: when something throws back light or heat without absorbing it
Solid: a substance with a fixed volume and shape
Temperature: a physical measure of how hot or cold something is
Volume: the amount of space that a substance occupies

TIPS

- Try putting insulators on the inside and reflectors on the outside of your cooler. The reflectors will reflect the heat back towards the sun, while the insulation will slow any heat that is not reflected. Examples of reflectors you might have at home are mirrors or objects that have a polished or shiny surface. Examples of insulators you might have at home are objects made out of plastic and wood.
- Try leaving space around the ice cube in your cooler. Heat doesn't transfer well through air, so air can be good insulator if it's trapped inside of something else.
- Any open space can allow for the transfer of heat, so try making a cooler that closes entirely around the ice cube.
- Think about how other coolers or refrigerators are built – you can use them for inspiration!

Talk like a "cool" engineer!

1. When an ice cube melts, it changes from a solid to a liquid.
2. Heat transfer caused the ice cube to melt when I placed it in the sun.
3. The reflectors outside of my cooler prevented heat transfer by reflecting the heat back towards the sun.
4. The insulation inside of my cooler slowed down heat transfer to the ice cube.

Want to learn more about the flotation device challenge? Check out the links below:

Why Ice Melts (video)
https://www.youtube.com/watch?v=uBn5DFyR5-I

How Does a Refrigerator Work? (video)
https://www.youtube.com/watch?v=EIP3pSio7-M

Heat Energy (video)
https://www.youtube.com/watch?v=xGKg3TSO4v8

Real World Physics: Heat Transfer
https://www.real-world-physics-problems.com/heat-transfer-for-kids.html

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