



## Keep the Coffee Hot!



### Upper Elementary STEM Mini-Project

**Dear Junior Scientist,**

Now that you're spending a lot of time at home around some grown-ups, you may have noticed that we often sip warm drinks like coffee and tea! I personally love having a nice hot cup of coffee with some soymilk and a spoonful of sugar.

Being at home and having kids around keeps us grown-ups quite busy. Sometimes, I am so busy making breakfast, cleaning up, making lunch, and changing smelly diapers that my coffee gets cold before I've had a chance to drink it! How disappointing is that?!

It's about time that things changed! We need your help! How can you design a sleeve for a mug that can keep a hot drink hot for longer? It should work the way a sweater keeps us warm when it's cold outside. I know you can do it! Before you get started, I'd like you to write down your thoughts on the **Brain Warm-up** page.

Good luck,

The ESD 112 STEM@Home Team!

## Brain Warm-up: How can we keep our coffee hot?

Write down your ideas in the chart below.

What do I notice about the problem?	What do I wonder about the problem?	What do I know about the problem?

## Let's talk!

An **insulator** is a material that does not easily allow heat to pass through it. It keeps heat either *trapped in* or *trapped out*. How do we use insulators to keep things warm in the winter by trapping the heat in? What are some ways that we use insulators to keep things cool by trapping the heat out? Talk with a grown-up and see if you can come up with some ideas.

## Task 1: Investigate Stop the Heat from Escaping!



An **insulator** is a material that does not easily allow heat to pass through it. In this experiment you will try to figure out which material best *insulates* the mug by keeping the heat trapped in the water for longer.

### Materials you will need:

- 4 glass or ceramic cups that are very similar (drinking cups will do)
- Hot tap water that is not boiling (ask a grown-up for help)
- Aluminum foil
- Felt
- A wool sock (optional)
- Plastic
- Wax paper
- Cardstock
- Construction paper
- Digital thermometer (optional)



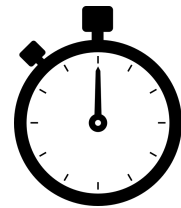
Let's explore the question: Which materials are better at keeping heat trapped in a drink?

**Directions:**

- In a minute, you will be wrapping cups with different materials to see how well they stop the heat from escaping. You can leave one unwrapped to see what happens when there is no sleeve. But before you start, make a prediction on your **Investigation Guide** page where it says, "My Prediction."
- Let the experiment begin!

**Round 1 of tests:** Decide which three materials you will test first.

1. Wrap 3 cups with the materials of choice and use the rubber bands to hold in place. Leave one unwrapped to see what happens when there is no sleeve
2. Pour hot tap water in each cup. It should be hot enough for you to see some steam but not so hot that it can burn you. Please ask a grown-up for help for this part! Ask a grown up to use their phone to put on a stop-watch so you can keep track of time.
3. Dip the tip of your finger quickly into the cup and pull it out. How hot is it? If your family has a digital thermometer, you can use that as well to measure temperature (Don't use a mercury thermometer or it could explode!). Record your observations in your **Investigation Guide**. Repeat with your other three cups. Make sure you are recording observations.
4. Wait 10 minutes and repeat step 3. Make sure to write down your observations in your log.
5. Keep testing the way the temperatures feel for the next 30-40 minutes.



**Round 2 of tests:** if you feel that none of your materials did well, pick 3 more and try again! OR, try combining some materials and see what happens!

6. Repeat steps 1-5 using different materials to insulate.

**What happened?** Look at the data you collected. Which materials were good at insulating and which ones were not? Write and draw your findings in your **Investigation Guide**.

# Investigation Guide

**My prediction:** Which insulator do you think will trap the most heat? Which one will trap the least? Draw your ideas below and use words to explain your thinking.

**Round 1:** Write down your observations of temperature. Use this scale to collect your data: **5= Super hot, 4=hot, 3=warm, 2=cool, 1=cold**

Material	0 minutes	5 minutes	15 minutes	25 minutes	35 minutes
No insulator	5				
foil	5				
paper	5				
plastic	5				

**Round 2:** Write down your observations of temperature. Use this scale to collect your data: **5= Super hot, 4=hot, 3=warm, 2=cool, 1=cold**

Material	0 minutes	5 minutes	15 minutes	25 minutes	35 minutes
No insulator					

**Making sense of my data: What did you find?**

What did you find out? Which materials kept the hot water hotter for longer? Which materials were better at **insulating** and which were worse? Write and draw your ideas below. Please use the word **insulator** when you describe your thinking.

## Designing the cup warmer



Great job investigating which materials worked great at trapping heat and which ones did a lousy job and keeping things hot!

**Materials:** materials from your previous experiment, other materials that you are allowed to use from around the house, scissors, tape.

**Planning the mug sleeve:** What materials would you like to use to design your insulating sleeve? Make sure that you use materials that will keep that drink as hot as possible. Also, the sleeve needs to fit on your parent or guardian's favorite mug! Before creating, use your **Model of my Insulating Sleeve** paper to draw a picture of your plan.

**Then, Create!** Have fun building your mug sleeve warmer for the awesome grown-up in your home! Add stickers, drawings, or other things that will make it extra special.

**Test it out** to see if it works like it is supposed to. If not, no worries! How can you fix it to make it work better?

Give the sleeve to the lucky grown-up!



Thank you, STEM Superhero for helping to solve a problem in your home! Check out [www.stemmaterials.org/stemathome](http://www.stemmaterials.org/stemathome).



Share Your Idea! Ask a grown-up to share a picture or video of your shelter to our Facebook page STEM@ESD112 or Tweet us at @STEMesd112

# Model of My Insulating Sleeve

Draw your plan and use words/arrows to show your thinking.

- Which materials will you be using?
- Why are you choosing to use those?
- How will your sleeve trap the heat inside the mug?