POLAR

# Walk

Leader Guide

Style Engineers

Fashion through science

WITH THIS ACTIVITY

- Student Handout

MODULE


We are Engineers!


Movement Improvement


Marvelous Materials


Smart Clothing


Patternmaking Tools n' Tech

## Big Picture

Heat moves from warm objects to cold. A person in contact with a cold surface loses body heat to the colder surface via conduction. Insulation is a protective layer that prevents or slows that heat transfer. Materials that contain trapped still air are good insulators, because air is an excellent insulator. Thickness offers better protection against conductive heat loss than thin layers of the same material.

## What's the goal?

To identify the best insulating materials for preventing conductive hear loss in cold temperatures.

## Materials

**What they need: (per group)**

- Thin socks (for control measures)
- Comparison charts

**What you need: (per leader)**

- Large block(s) of ice

**Supplies to Share**

- . 1 wool felt insole
- 1 aerogel insole
- 1 open cell foam insole
- 1 closed cell foam insole
- Large block of ice
- Large plastic dish pan (optional)
- Towel
- 2 Plastic garbage bags
- Whiteboard/big sheets of paper
- Dry erase markers
- Temperature gun

**Prep Time: 20 Minutes**
**Activity Time: 45 Minutes**
**Difficulty: Level 1**

**VOCABULARY**

**Conduction –** heat transfer through physical contact, with temperature moving from the warm surface to the cold surface via molecular movement inside the materials.

**Insulation -** a protective layer that prevents or slows conductive heat transfer, helping us stay warm or cool.

**Open cell foam** – a foam material that has air spaces that are not enclosed (like a sponge).

**Closed cell foam** – a foam material that has sealed air pockets (like thin craft foam).

**Aerogel –** a synthetic ultralight material derived from a gel, but with liquid replaced by air, dense and with low conductivity

# Preparation

1. Purchase shoe insoles online or at craft, shoe, or drugstores. Try to find insoles of similar thickness in different materials. You might purchase open cell foam at a craft or sewing store and cut insoles yourself to provide a thicker insole.
2. Print copies of the comparison chart for each participant.
3. Fill the large plastic dishpan filled three-quarters full of water and place in a freezer. Allow enough time for the water to create a solid block of ice, at least 48 hours.
4. Place a plastic garbage bag on the ground/floor and cover it with a towel. Place the block of ice (or basin with ice) on top of the towel. Finally, place another bag on top of the ice. The plastic bags both protect the floor and keep feet and the insoles dry.

# Grouping

Individual, though findings will be compared with the entire group.

# Let's get started!

***Part One***

1. Begin by passing the four insoles around so the young designers can assess their different thickness, flexibility and weight.
2. Which of these will keep your foot the warmest? Predict which sole will be the best and rank it #1 (warmest) and then predict the other three materials from #2 to #4, warmer to colder. The control sock is always rated #5 (coldest.)
3. Place the aerogel insole on the block of ice. Wearing socks on both feet, stand with one foot on the aerogel insole and one on the ice (control) for 10 seconds.
4. Record your rating of the insulation ability of the aerogel insole, 1 to 4.
5. Repeat steps 3-4 for the other insoles, recording results on the chart.
6. Based on above data, rank the materials from 1 (warmest) to 4 (coldest.) If you ranked two or more insoles the same, compare again by stepping on them at the same time on the ice. Adjust their ranks according to this second test.

***Part Two***

1. Warm your feet, then place an insole on the ice again, step on it for 10 seconds, then step off.
2. Using the temperature gun, point the laser at the ball of your foot.
3. Record your foot temperature for each insole in the chart and compare to the above data.
4. Repeat for each insole.

- **Tips:**
- Because ice becomes slushy as it thaws, prepare extra blocks of ice, bringing out replacement blocks when needed. You may purchase ice blocks or freeze your own.
- Ask the young designers to support one another when they are standing on the ice as it can be slippery.
- A wide variety of insoles can be found at www.amazon.com or at www.theinsolestore.com.

- Infrared laser temperature guns can be purchased at home improvement centers or online. They come in a range of prices but the lower priced items are suitable for this activity. Common features are switches that turn the laser off/on and allow for digital readings in both Centigrade and Fahrenheit.
- **ALERT!** Caution students NOT to point the laser gun at anyone's eyes.
- Groups may prefer recording data on a large communal chart (poster, newsprint, chalkboard or Smart Board) for easier viewing and discussion.

## Wrap it up

1. Which insole provided the best thermal insulation? Which provided the least? Is thicker always better?

2. How do your predicted rankings compare with the actual performance ranking?

3. Which sole was less effective than you predicted?

4. How do the temperature gun results compare with your personal evaluations?

## Take it further

1. How could these materials be used as insulation in a different item of clothing, such as a glove, hat or coat?

2. What considerations in addition to insulation are needed when designing a garment for cold weather?