Keep it Warm

Have you ever wondered how a thermos keeps your drink cold or your soup hot? Discover how thermal energy transfers between different materials to determine if they are conductors or insulators. Elaborate on your observations to design your own insulated cup.

TEKS:

SCI 4.6B: The student can differentiate between conductors and insulators of thermal and electrical energy.
SCI 5.5A: The student can classify matter based on measurable, testable, and observable physical properties, including mass, magnetism, physical state (solid, liquid, and gas), relative density (sinking and floating using water as a reference point), solubility in water, and the ability to conduct or insulate thermal energy or electric energy.
SCI 5.3C: The student connects grade-level appropriate science concepts with the history of science, science careers, and contributions of scientists.

Materials:

- Aluminum foil or metal cup
- Cold pack – can be purchased here (instant) or here (hot/cold reusable)
- Glass cup
- Hot pack – can be purchased here (instant) or here (hot/cold reusable)
- Paper
- Paper cup
- Pencil
- Plastic cup
- Styrofoam cup
- Variety of materials to insulate the cup (cotton balls, aluminum foil, bubble wrap, felt, etc.)

How To:

1. Activate your hot and cold packs. If you have instant packs, massage or shake your pouches to stimulate the hot/cold chemical reaction. If you are using reusable packs, microwave and/or freeze your packs prior to the activity.
2. If you do not have a metal cup to use, create a metal cup out of a 12 x 12-inch sheet of aluminum foil. Cut the piece of aluminum foil and shape the aluminum around the outside of a glass. Pull the aluminum cup off the glass carefully. Reshape as needed.
3. Gather all the different kinds of cups (aluminum/metal, glass, paper, plastic, and Styrofoam) and set them up to be tested.
4. Place the hot pack and the cold pack along the inner side of the aluminum/metal cup and the paper cup, respectively. Wait for 30-60 seconds.
5. Carefully touch the outside of the cups and observe whether you can feel the hot/cold pack's temperature through the cup. Use the piece of paper and pencil to record your observations.
6. Repeat this process to test both the hot and cold pack in each type of cup. Record your findings.
7. After you have completed a scientific investigation of these materials, challenge yourself to design your own insulated cup that can hold both hot and cold beverages! You can use a variety of materials available around you to create this insulated cup like bubble wrap, cotton balls, etc.

   Challenge: Design and create a prototype of an insulated cup

   Here are some probing questions to help get started, but be as creative as you want!

   - What other materials are insulators?
   - What if my design was double walled?
   - Which cups that I tested were the best insulators?
   - Which cups are sturdier than others?
   - How can I design the insulated cup to block the flow of thermal energy between the drink and outside of the cup?
   - What is most important to you in a cup? A lid? A straw? No sweat/condensation outside the cup?

STEM Explanation:

Did the cups made of different materials all react the same to temperature? No! The hot or cold sensation you feel on the outside of each cup occurs because of the transfer of thermal energy. Thermal energy can travel in many ways, but the main way is through the touch of solids, called conduction. The hot or cold particles that make up the hot/cold pack travel from the pack to the cup, and then to your hand. However, not all the cups let the thermal energy flow. When materials stop the flow of energy, they are called insulators. When materials allow the flow of energy, they are called conductors. Therefore, insulated cups are made with these considerations in mind.

Insulated, also known as thermal, cups are used regularly to keep drinks ice cold or steaming hot! This all started back in the late 1800s to create a piece of science laboratory equipment that could insulate your touch from unsafe chemicals inside. A scientist named James Dewar sparked this process by creating a flask using two glasses with a vacuum between them, and this idea has developed into the insulated cups, water bottles, and thermoses we use now. These insulated cups are made using a stainless-steel cup inside to conduct the temperature of the drink within. Most often, a metal cup is used on the outside as a protected layer if your cup is dropped. The science of using a vacuum, a space without matter, between the metal cups creates an insulating barrier because there are no particles for the thermal energy to travel through. Now that is some great insulation!

Career Connection:

New product introduction engineers are responsible for the quality control of new products. NPI Engineers work in the design, development, production, and testing of new products to ensure they are safe and maintain a high quality for customers.

Resources:

https://hydrationanywhere.com/scientist-behind-insulated-water-bottle/
https://www.ozmo.io/really-differences-insulated-vacuum-thermal-cups/
https://www.amazon.com/Grabber-HWPP10-Pack-Warmers-10-Pairs/dp/B007ID2ILQ/ref=sr_1_1_sspa?s=hpc&ie=UTF8&qid=1534881337&sr=1-1-spons&keywords=hand+warmers&psc=1
https://www.amazon.com/IceWraps-Instant-Cold-Breakable-Packs/dp/B075ZL3RBH/ref=sr_1_1_sspa?s=hpc&ie=UTF8&qid=1534881445&sr=1-1-spons&keywords=instant%2Bcold%2Bpack&th=1
https://www.amazon.com/Roscoe-Reusable-Microwaveable-Treating-Injuries/dp/B00AZ72XA8/ref=sr_1_5_s_it?s=hpc&ie=UTF8&qid=1534881545&sr=1-5&keywords=hot%2Bcold%2Bgel%2Bpack%2Breusable&th=1

