Part 1: How fast does your butter melt?

Materials:

- Stick of butter and a knife to cut the butter
- A tall glass
- A plastic spoon/knife/fork
- A metal spoon/knife/fork
- A wooden pencil/spoon/knife/fork
- Hot water

Procedure:

1. Heat up water on a stove or use a kettle.
2. Cut three small rectangles (about ¼ inch thick) from a stick of butter.
3. Place the pencil in the glass with the point up and put the metal and plastic spoons with the spoon side facing up.
4. Place one rectangle of butter on the end of the metal spoon, one on the end of the plastic spoon and one on the tip of the pencil.
5. Pour the hot water into the glass so that it is almost full.
6. Watch the butter on the metal spoon, plastic spoon and pencil. Be careful not to touch your spoons or pencil. What happens?

Activity extensions:

- Try wrapping your metal spoon in bubble wrap. How long does the butter take to melt? Does it melt slower than the butter on the metal spoon?
- Try wrapping aluminum foil around the plastic spoon. How long does the butter take to melt? Does it melt faster than the butter on the plastic spoon?

Part 2: Polar bear blubber

Materials:

- Bucket or big pot
- Cold water
- Ice
- Gallon Sized Ziploc bags (at least 4)
- At least 2 insulating materials
    - Shortening (about 4 tbsp.)
    - Butter (about 1 stick/8 tbsp.)
    - Cotton balls
    - Sand
    - Bubble wrap
- Thermometer (optional)

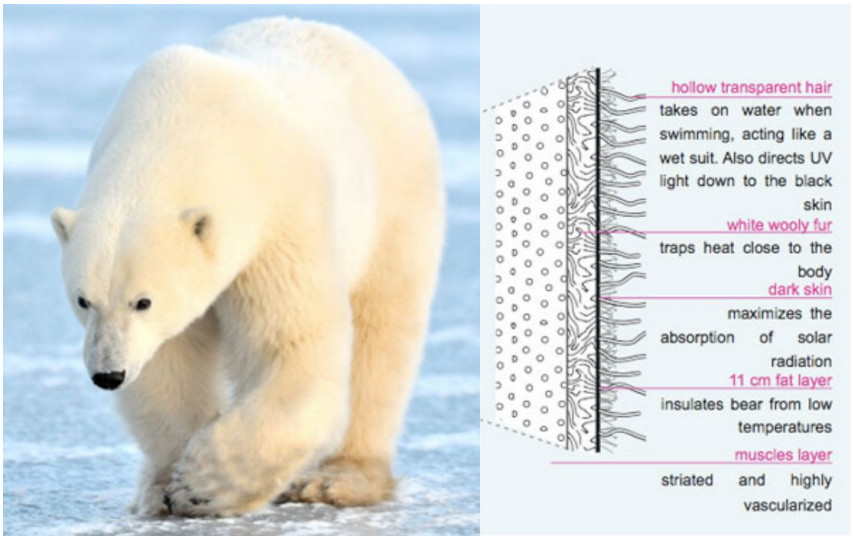
Procedure:

1. Fill a pot/bucket up to halfway with cold water.
2. Add some ice to make the water chilly.
3. Take the first ziploc bag and fill it with one of the insulating materials.
    a. If you use butter, let it thaw or melt it slightly in the microwave so it is spreadable.
4. Take the second ziploc bag and fill it with one of the other insulating materials from the list.
    a. If you use cotton balls, fill up your ziploc bag.
    b. If you use sand, fill up the bottom ⅓ of the ziploc bag.
5. Place your hand inside a third ziploc bag and place your bagged hand inside the bags of insulating materials.
    a. If you used butter or shortening, spread the material around your bagged hand.
    b. If you used cotton balls, make sure your bagged hand is covered completely by the cotton balls.
    c. If you used bubble wrap, it's easier to wrap your bagged hand in bubble wrap and place your bubble wrapped bagged hand inside the ziploc bag.
6. Now take your bagged hand inside the bag of insulating material and place it into the cold water. What happens?
7. Remove your bagged hand from the bag of insulating material and place it in a fourth empty ziploc bag.
8. Put your double bagged hand in the cold water. Do you feel a difference between your hand in the empty bag and your hand in the bag of insulating materials?

Activity extensions:

- Try the different materials on the list. Are some insulators better than others?
- Find some other materials in your house to see which ones work as insulators and which ones work as conductors.

- If you have a thermometer, try the same activity with hot water. This time, put the thermometer in the bags of insulating materials instead of your hand. What happens to the temperature in the bags of insulating material versus the bag of air?



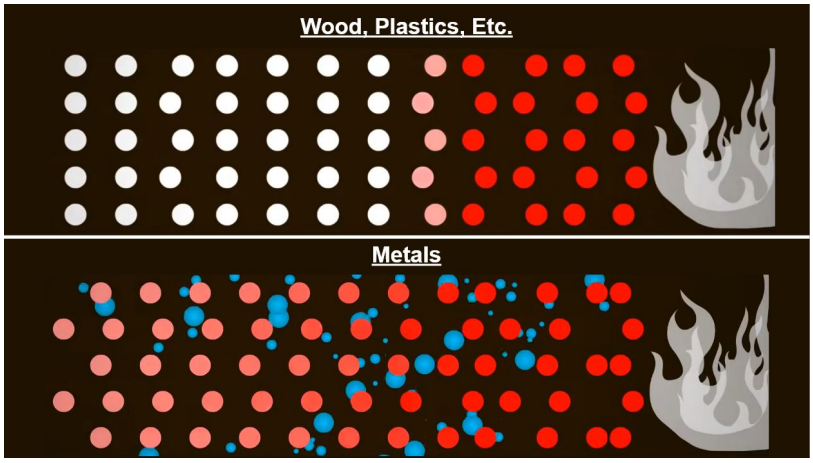
What's happening?
In this demo, we see butter melting at different speeds and that we can keep our hand warm, even when it's in a bucket of ice. How is this possible? To understand these demos, we first have to understand how heat works.

When we heat something up, we are causing all of the tiny particles that make up the object to move really quickly and collide with the other particles. Heat is transferred through a process called **heat conduction**. This occurs when a material gets heated up on one side and the particles on that side start vibrating and colliding into neighboring particles so that they also get heated up. Think of these particles like dominoes, once one starts vibrating and moving, they all begin to move. In this way, heat can be transferred between objects that are touching each other. It is also important to note that heat moves from hot objects to cold objects.

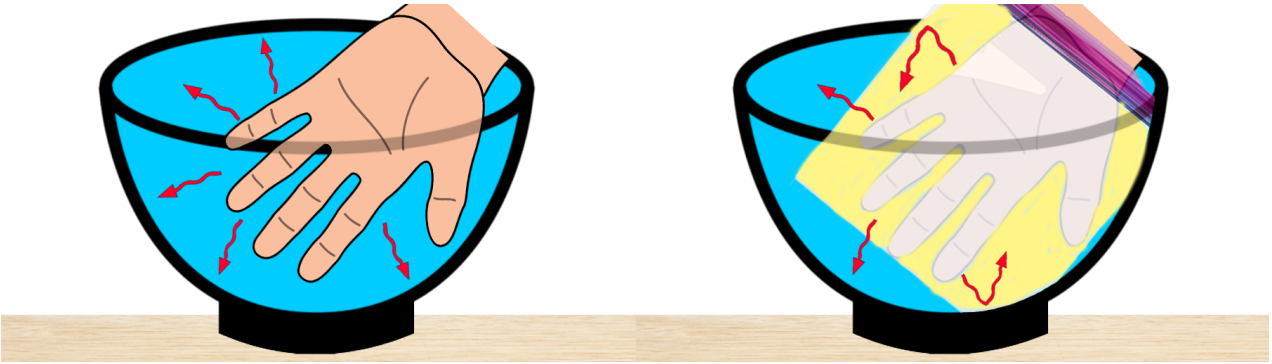
There are lots of different types of materials out there and some of them transfer heat much better than others. Materials that are really good at transferring heat are known as **conductors**. Conductors have a specific type of particle that moves around really easily; these are called free electrons. The free electrons move around a lot and collide with the neighboring particles and cause them to vibrate and heat up. Materials that are good conductors of heat include things like aluminum foil, iron or copper.

What about the materials that are not good at transferring heat? These materials are known as **insulators**. Insulators do not have free electrons that move around easily. Therefore it's much harder for the particles to move around and collide with each other. Examples of insulators include the materials we used today, like shortening, butter, oil, cotton or sand. Insulators are

able to protect materials from heat transfer, since they don't have particles that move around easily. For example, polar bears have a thick layer of blubber which is a fat similar to shortening or butter. The blubber inside polar bears prevents the heat inside their bodies from transferring to the cold air outside, keeping them nice and warm!



In the first demo, we wrap our hands in similar materials to a polar bear's blubber. When we do that, we keep our body heat from transferring to the cold ice and our hand stays warm. If we don't wrap our hand in anything, there's nothing preventing heat transfer and so our body heat gets transferred to the ice and our hand feels cold.



In the second demo, when we put the butter on three different materials and add hot water, we can tell which materials are conductors and which are insulators. We see that the butter on the metal spoon melts first, but the butter on the pencil and the butter on the plastic spoon slightly melts, if at all. We can tell that the metal spoon is a good conductor because the heat is transferred to the cold butter right away and begins melting. However, the butter takes longer to melt on the pencil and on the plastic. These materials are known as insulators and prevent the heat from the hot water from transferring to the cold butter.

By knowing if materials are conductors or insulators, we can use them to our advantage. So, while designing a pot for cooking, we make it with a conducting material so that the pot gets heated up fast. However, while designing winter-proof clothing, we use insulating materials such as fleece or wool. Thus, it is useful to understand how heat conduction works!

These YouTube videos have a good visual explanation:

https://youtu.be/NKZSImhSn6k
https://youtu.be/9joLYfayee8