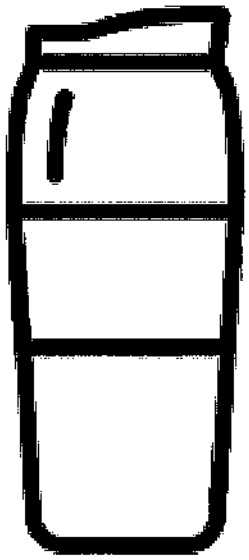
Science and Engineering
"Survival Thermos:
Design Challenge

In most (not all) households in America today, you can turn in a faucet, wait just a few moments and have clean hot water. HOT WATER. Hot water is used to cook with. Hot water is used to clean with. We use it to mix formula for baby bottles. We bathe and shower with it. We can easily buy containers made to keep hot water hot at the local Dollar store or Walmart when we travel. What a luxury we have. We can easily take hot water for granted and forget that in a lot of places on Earth, it is an effort to get hot water, and a challenge to transport it.

In this design challenge, you and your team are to **design, create, and test a device (survival thermos) that will minimize the loss of thermal energy, thus keeping hot water hot longer.**



Energy Transfer Summary

All matter is made of tiny particles that are too small to see. The particles are in constant motion.

Objects in motion have kinetic energy. Particles are objects in motion, so they have kinetic energy. The faster a particle moves, the more kinetic energy it has.

Kinetic energy is related to heat. The faster the particles in a substance move, the hotter it is.

Energy can move, or transfer, from one particle to another when particles collide. Energy always transfers from a higher-energy particle to a lower-energy particle. The transfer of kinetic energy from particle to particle as a result of contact is called conduction.

Temperature is a measure of the average kinetic energy of the particles in a mass.

Matter heats up and cools down because of energy transfer at the particle level.

Record Your Thinking Here

One fact that stands out to me is...

This reminds me of...

Now I wonder...

After reading the "Energy Transfer Summary", complete the following challenge.

Consider the glass of ice water below. The water is 15 degrees Celsius, the Ice is 0 degrees Celsius, and the air around the glass is 25 degrees Celsius.

a) Answer the questions in the text box
b) Label the temperatures
c) Draw arrows to show the flow of energy with in and around the glass of ice water.

Based on the text...

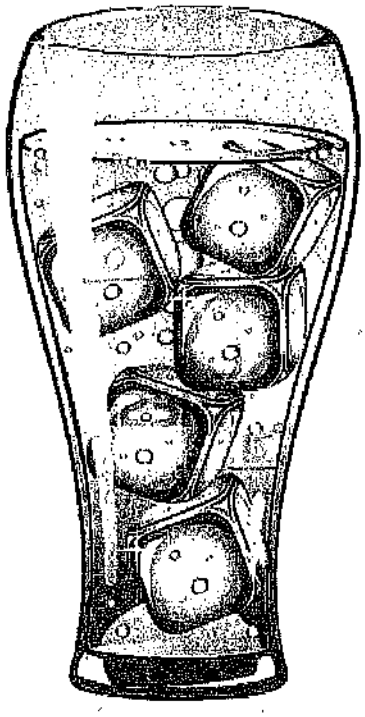
1) Temperature is actually a measure of the _____ energy with particles.

2) This is also known as energy in _____.

3) According to science, when substances touch and conduction can happen, energy will flow within a system from _____ energy levels to_____energy levels?

4) The flow of energy will be greatest when the level have a _____ difference between them.

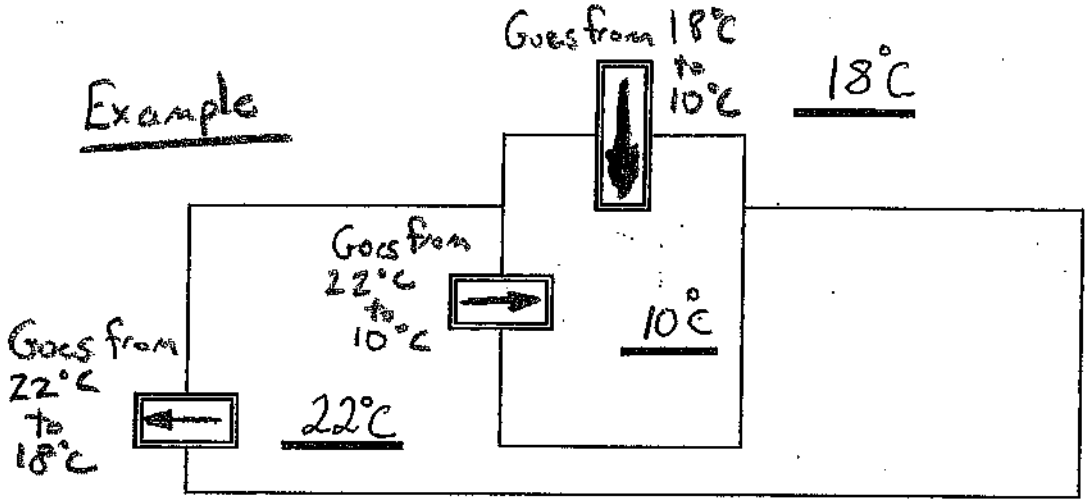
5) The energy will cease to flow when the energy levels are _____.



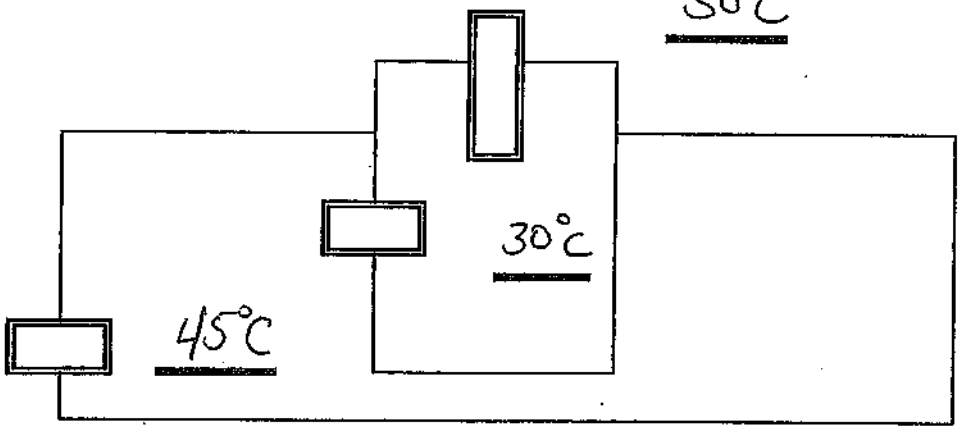
What questions to you have about this?

For each 3-part energy "system", place arrows in the direction of the energy flow.

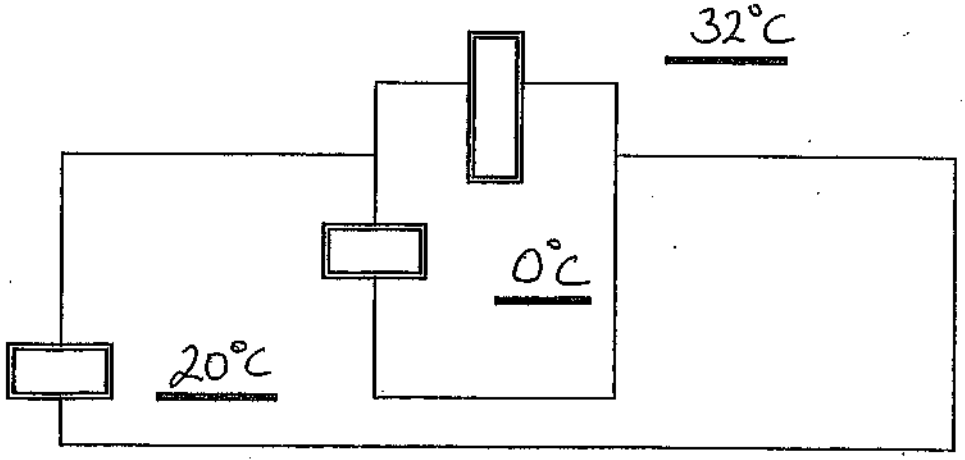
Example



1)



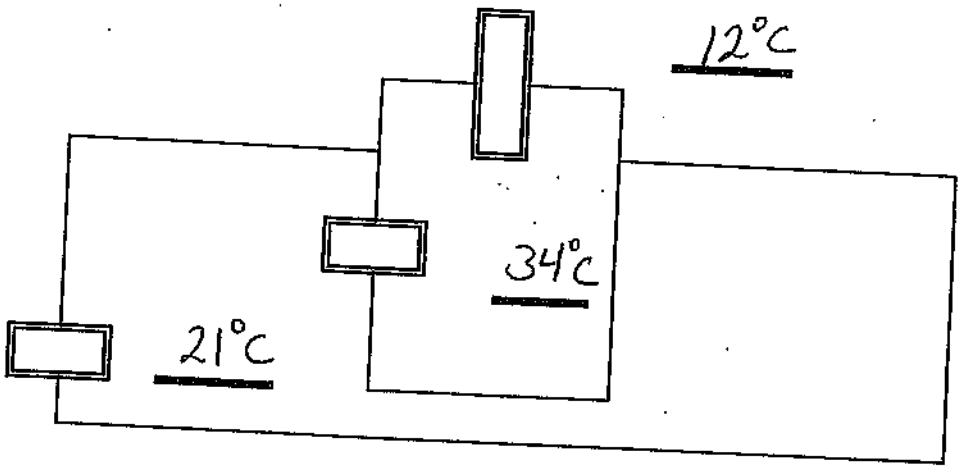
2)



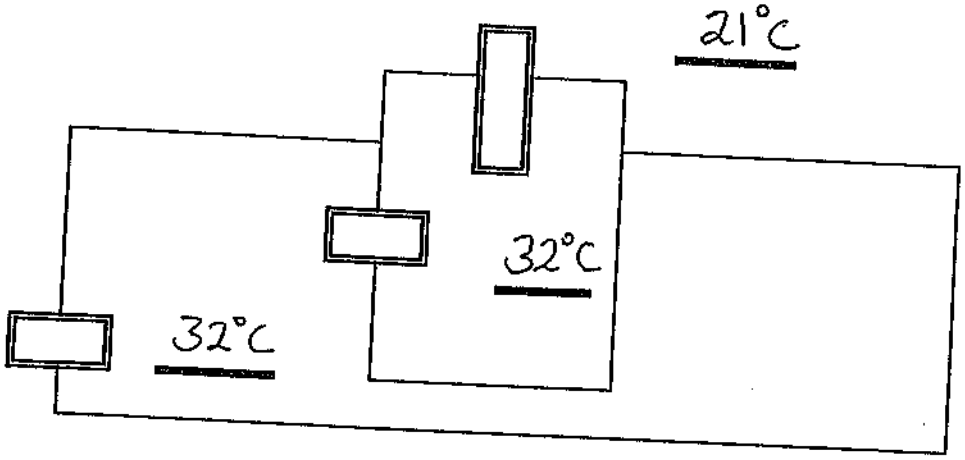
3) Stop and Think

Energy will always move from _____ to _____.
We measure heat energy by taking the _____.
If you have a substance, the particles of that are in a _____ state have the highest energy and movement. The particles in the _____ state have the lowest energy and movement.

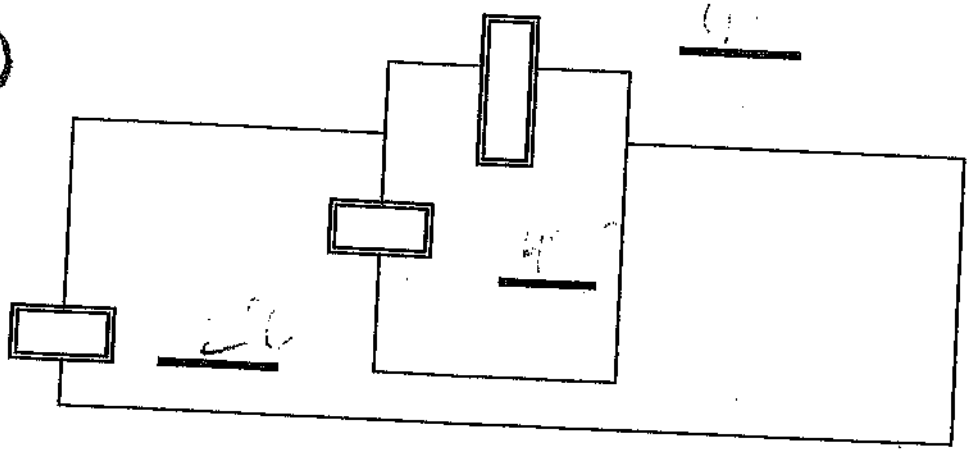
4)



5)



6)



For this one, you add your own temps and show energy flow direction with arrows. Temps on lines. Arrows in boxes.

Heat Transfer

{Radiation, Conduction, Convection}

It is important to understand the processes of heat transfer when learning about the earth because without the transfer of heat, the processes that occur within our earth would not happen. Understand that HEAT TRAVELS, cold does not. For example, when you hold a cup of hot chocolate in your hands, the heat travels from the hot chocolate to your hands. There are three ways that heat travels: conduction, radiation, and convection.

Conduction is the transfer of heat from a warmer substance to a cooler substance through direct contact. When two substances or objects come together, their particles collide. The energy from the faster moving particles (the hotter substance or object) is transferred to the slower-moving particles, until the particles in both substance are moving at the same speed. An example of conduction would be touching the cookie sheet that just came out of the oven. Ouch!

Radiation is the transfer of heat through space on electromagnetic waves. Do you ever feel heat, but you can't see it or physically touch it? That would be radiation. An example of radiation would be when you are outside and you can feel the sun's rays on your face. Convection is the transfer of heat in a fluid through currents. When you boil a pot of water, the water closest to the burner gets hot st, becomes less dense and rises while the cooler, more dense fluid goes to the bottom of the pot, creating a current. The warmer water rises while the cooler water sinks.

The process of convection explains why tectonic plates move. Convection currents occur in the mantle and outer core with the heat source being the center of the earth. The rock closest to the core gets hot, less dense, and rises towards the surface or crust of the earth. At the same time, the rock furthest from the core is cooler and more dense and is pulled by gravity towards the core creating a constant current. These currents are the most important & necessary aspect of earth processes such as mountain formation, sea-floor spreading, and subduction. This movement also causes earthquakes, volcanoes, and continental drift.

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Research...Visit two to three different sites and make note the information/facts they offer for the given prompts.

PROMPT 1: What is a thermos and how does a thermos work?

Source (Site) 1	Source (Site) 2	Source (Site) 3

Your final summary for the prompt using your findings.

Research...Visit two to three different sites and make note the information/facts they offer for the given prompts.

PROMPT 2: What is a an insulator? How do they work? Examples? (Capture notes, drawings, and examples).

Source (Site) 1	Source (Site) 2	Source (Site) 3

Your final summary for the prompt using your findings.

Research...Visit two to three different sites and make note the information/facts they offer for the given prompts.

PROMPT 2: What is a a conductor? ~~Who~~ How do they work? Examples? (Capture notes, drawings, and examples).

Source (Site) 1	Source (Site) 2	Source (Site) 3

Your final summary for the prompt using your findings.

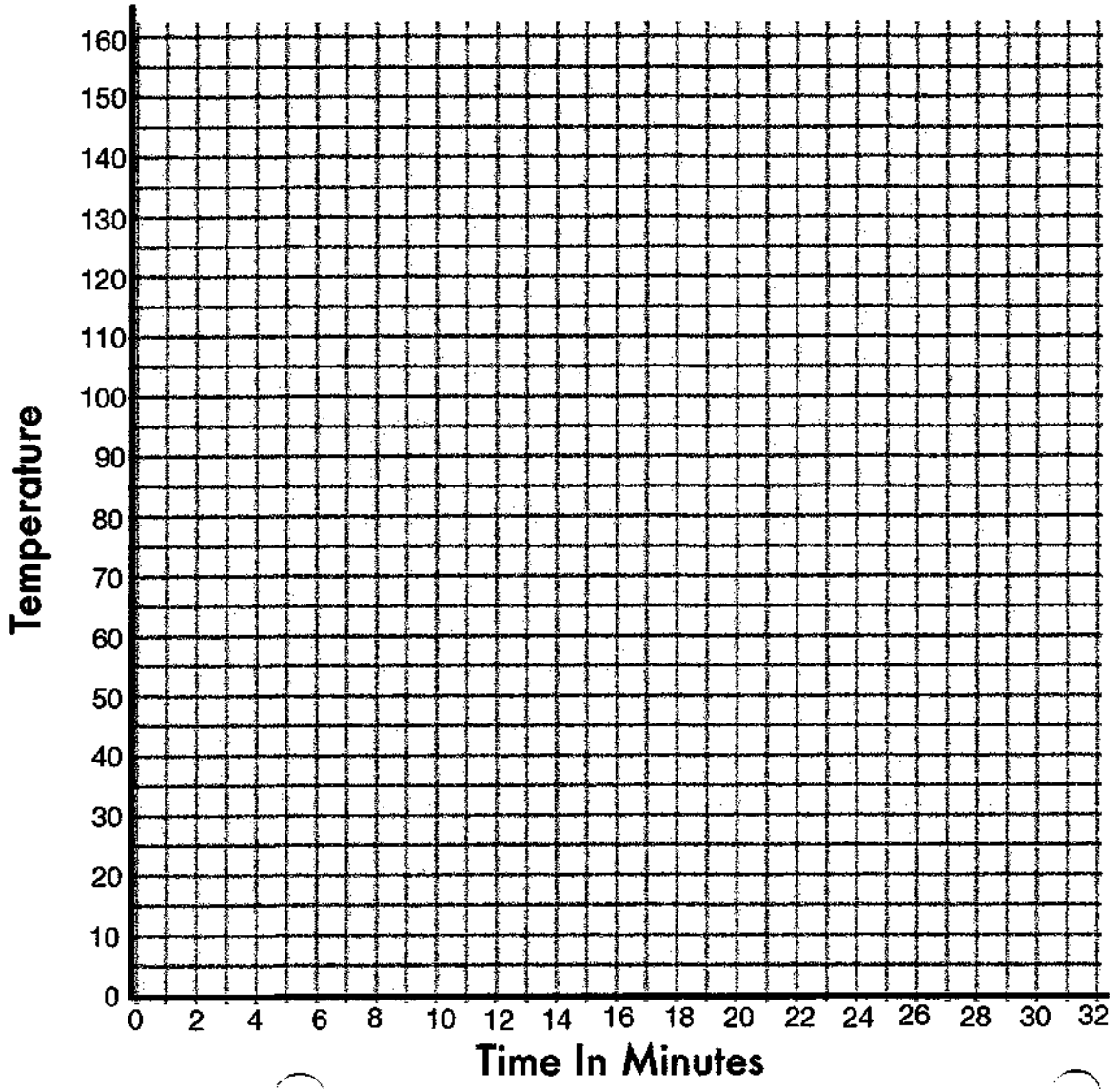
Getting your Baseline.
In order to see if your deign is effective, we need to have the baseline heatless of hot water without the use of anything to compare to.

Thermal Energy Transfer Baseline

Time	Temperature
Start Temp (0 minutes)	
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	
14	
15	
16	
17	
18	
19	
20	
21	
2	

Starting Temperature:_____ **Ending Temperature:**_____

Heat loss of our plain cup



Testing your design...

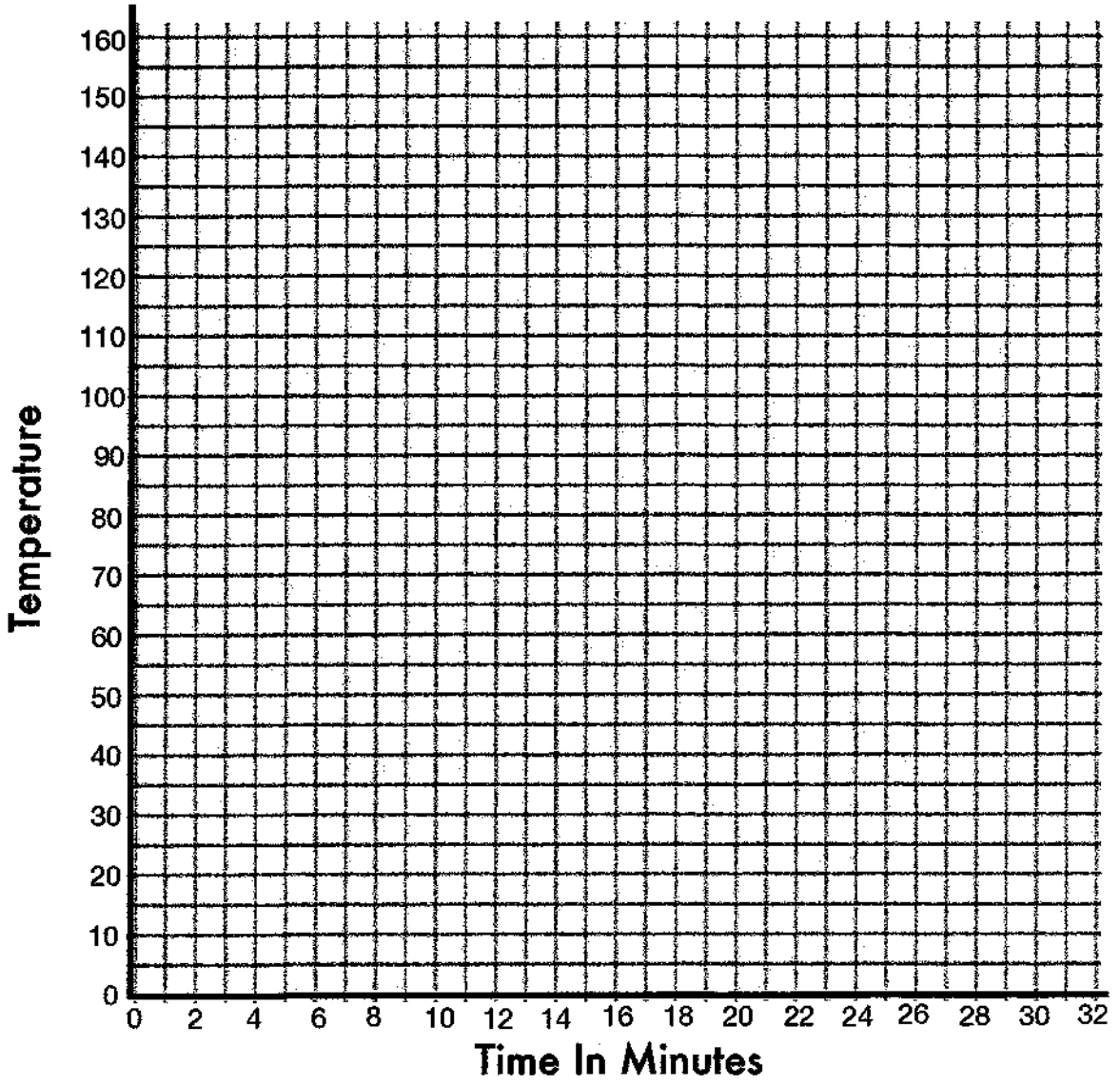
Once your prototype is build, you need to test it. Add 200ml of hot water to your thermos. Measure the heat loss over 22 minutes.

Thermal Energy Transfer Baseline

Time	Temperature
Start Temp (0 minutes)	
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	
14	
15	
16	
17	
18	
19	
20	
21	
22	

Starting Temperature:_____ **Ending Temperature:**_____

Heat loss of our "Survive Thermos"



Name _____

V. Reflect: Answer the following questions to reflect on your thermos data.

1. How much thermal energy (degrees) did your thermos lose from start to finish?

2. How does this compare with the amount of thermal energy lost by just the foam cup?

3. Was your device effective? Explain your answer.

4. In your initial design did you use more insulators or conductors? Why did you use one more than the other?

5. If you had an opportunity to redesign your thermos, what changes would you make?

6. Which would you use more in your redesign, insulators or conductors? Why?

On the attached sheet, design a final draft for an advertisement for your survival thermal device.

Ad MUST to have the following:

1) A brand name for your device that is unlike anything else.
2) A slogan that is connected to the purpose.
3) Product uses.
4) Reference to your data results to support effectiveness your device.
5) Reference to the science of your design using the words
   a. "Thermal Energy".
   b. "Transfer"
   c. "Insulator"
   d. "Conductor"

Quality Considerations To Address:

1) Uses the entire space.
2) Work is in color.
3) Work is neat (no erase marks, spelled right, neat coloring, sharp line and design)

Example of Effective Advertisement

Name: _____

The Thermos I chose was _____. (Make sure to put who made the thermos you chose.)

The reason I chose this thermos (must be more than just because how it looks)

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

Was this thermos made out of more insulators or conductors? How did this affect how well the thermos performs?

_____

_____

_____

_____

_____