

Appendix B

Summary of the Avatar-Based Simulation Task, “Keeping the Heat”

Keep it Cold Investigation: The students worked in small groups to study what happens to cold water in a cup when left out in the sun on a warm summer day (see Figure B1). The air temperature was 32 C. Savannah, Dev, and Ava worked together, and Jasmine and Ethan worked together. Each group monitored the temperature in cups of water as they were left outside on a warm day for 30 minutes. The water in each of the cups started out at the same temperature, 7 C. Half of the cups were made of foam and were fitted with foam lids and half were made of paper with paper lids. The students took the average of their combined data and entered it into a data table (see Table B). The students observed that the water in the foam cup changed its temperature more slowly than the water in the paper cup.

Figure B1

Keep It Cold Investigation Materials Set-up

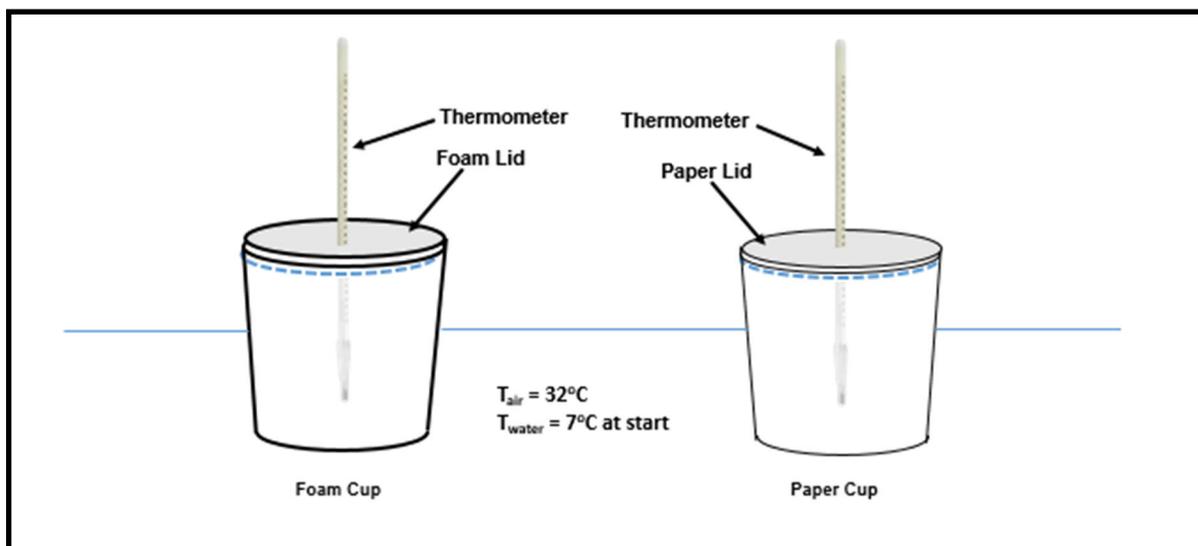


Table B*Keep it Cold Data Table*

Cup Type	Temperature (degrees Celsius) at Time			
	0 min	10 min	20 min	30 min
Water in the Paper Cup	7 C	11 C	14 C	16 C
Water in the Foam Cup	7 C	9 C	10 C	12 C

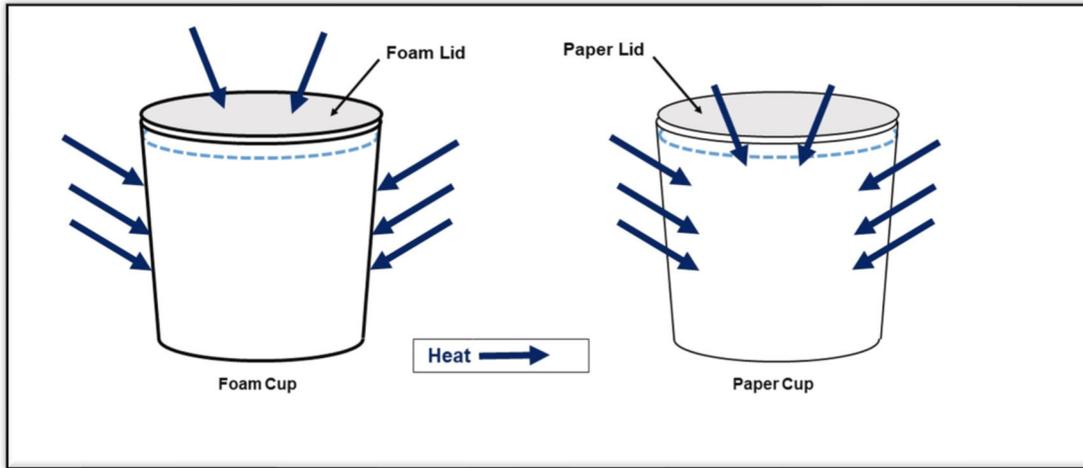
Description of Student Work: Each team was asked to (1) describe the differences in heat transfer between the air and the water in the cups, support their claim with evidence and clearly explain their reasoning, and develop a model to illustrate and support their argument, and (2) observe and critique the model and explanation provided by their classmates.

Savannah, Dev, and Ava's Response:

(1) Heat transfer occurs when the heat from the air enters the paper cup of water and warms it up. The foam stops the heat, so the temperature of the water in the foam cup does not increase like the temperature of the water in the paper cup. Foam keeps heat out, like the foam coolers we use for our sports drinks, so we used arrows to show that. The arrows in our model represent the heat energy that gets into the paper cup but can't get into the foam cup (see Figure B2).

Figure B2

Savannah, Dev, and Ava's Heat Transfer Model



(2) We like that the other group showed the particles of water and said that warm particles move faster than cold particles. One thing we don't agree with in their work is how they say that cold is escaping out of the cups of water. We think the water warms up because heat moves into the cup and the particles move faster, so we are not sure what they are showing with the cold particles on the outsides of the cups. We are also not sure why they used different colors for the water particles.

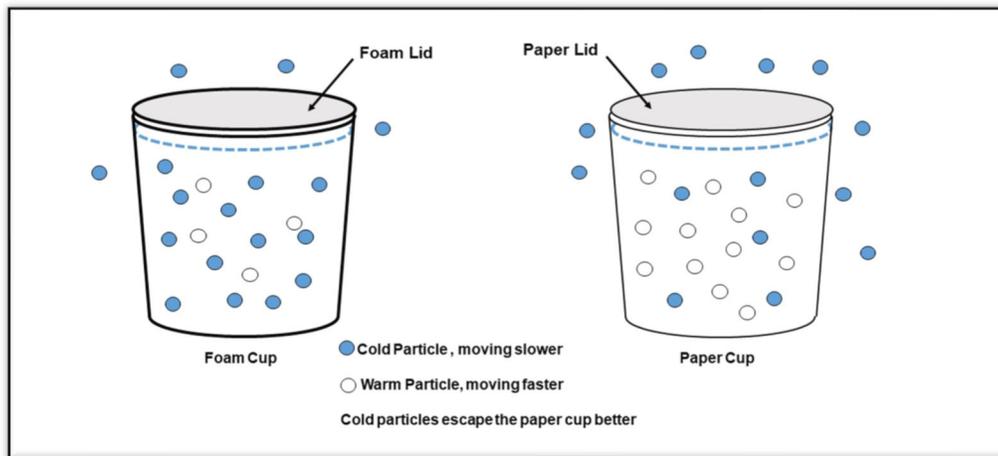
Jasmine and Ethan's Response:

(1) The difference in heat transfer in the different cups happens because the cold leaks out of the paper cups faster than the foam cups. The Keep It Cold data table shows that the water in the foam cup is still colder than the water in the paper cup after 30 minutes. That is because foam keeps most of the cold particles inside. More of the cold particles are able to escape from the paper cup, so the temperature goes up. We know that matter is made of particles, so we thought it was important to show that in our model (see Figure

B3). We used different colors to show the different temperatures of particles and also wrote that warmer particles move faster than cold particles.

Figure B3

Jasmine and Ethan's Heat Transfer Model



(2) Savannah, Dev, and Ava drew arrows to show heat transfer, but we think their arrows are going the wrong way. The arrows should show how cold moved out of the cups. They did not show any particles in their model or talk about their movement, and we think it is important to show this in the model.

For the complete task, see:

Online Practice Suite. (2021). Keep it Cold Performance Task. Pre-release task version developed under grant no. 2037983. <https://doi.org/10.17910/b7.1110>