1 Energy

Objectives

You will be able to

- Explain the difference between thermal energy and temperature.
- Construct an argument based on evidence.
- Make sure everyone contributes.
- Communicate your ideas and listen actively.

How do we use and control thermal energy in a system?

Evaluation and Feedback

To evaluate your work, you will

- Use the "Developing and Using Models" row of the Science and Engineering Practices Rubric.
- Use the "Engaging in Arguments from Evidence" row of the Science and Engineering Practices Rubric.

Task 1: Compare Thermal Energy and Temperature

As a group:

- Use your bodies to move around like particles in motion.
- Make sentences with the energy vocabulary.
- Predict and discover where there is more thermal energy in two cups of ice water.
- Decide where there is more thermal in two cups of hot chocolate.
- Create an energy concept map.

Vocabulary

- claim
- evidence
- heat
- kinetic energy
- observation
- particle
- potential energy
- reasoning
- temperature
- thermal energy
- transfer

Connect to the Culminating Project

Draw models to help your client

- Understand the difference between thermal energy and temperature.
- Understand how particles move within ice, water, and steam.
- Understand how the movement of particles affects the temperature of an object.

Part I • Particles in Motion

1. Use the PhET simulation as a model to act out the concepts of particle, kinetic energy, temperature, and thermal energy.
2. Discuss after the PhET simulation:
   - How did the movement of particles change after the **temperature** was increased?
   - Was there more or less kinetic energy after the **temperature** was increased?
3. How can you show particles moving slower or faster in a diagram?

   a. Decide on a diagram that your group agrees on for slow and fast motion of particles.

   b. Draw your final diagrams below and be prepared to share them with the class.

Slow Motion Particles	Fast Motion Particles

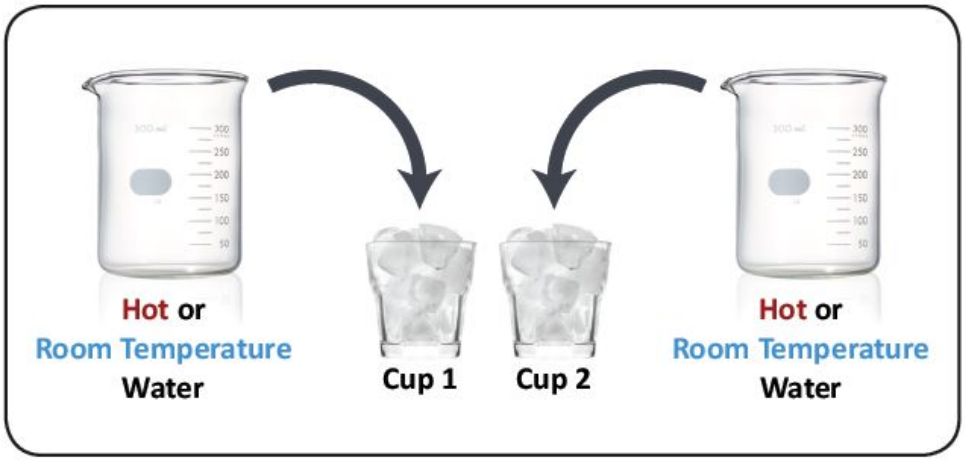
4. Write a sentence using the words in the parentheses plus the original term to show your understanding of each term.

Term	Definition	Sentence
particle	A **particle** is a small piece of the whole.	(water, ice)
kinetic energy	**Kinetic energy** is energy of motion.	(jet plane, car)
temperature	**Temperature** is the **average** amount of kinetic energy in a system.	(Pacific Ocean, swimmer in the ocean)
thermal energy	**Thermal energy** is the **total** amount of kinetic energy in a system.	(Pacific Ocean, swimmer in the ocean)
heat	**Heat** is the movement of *thermal energy transfer* from a hotter area to a cooler area. We will be using the term *thermal energy transfer* in place of *heat* in this unit.	(fire, marshmallow)

Part II • Thermal Energy and Temperature

You will watch three demonstrations conducted by your teacher. Think about the difference between thermal energy and temperature as you watch.

Procedure

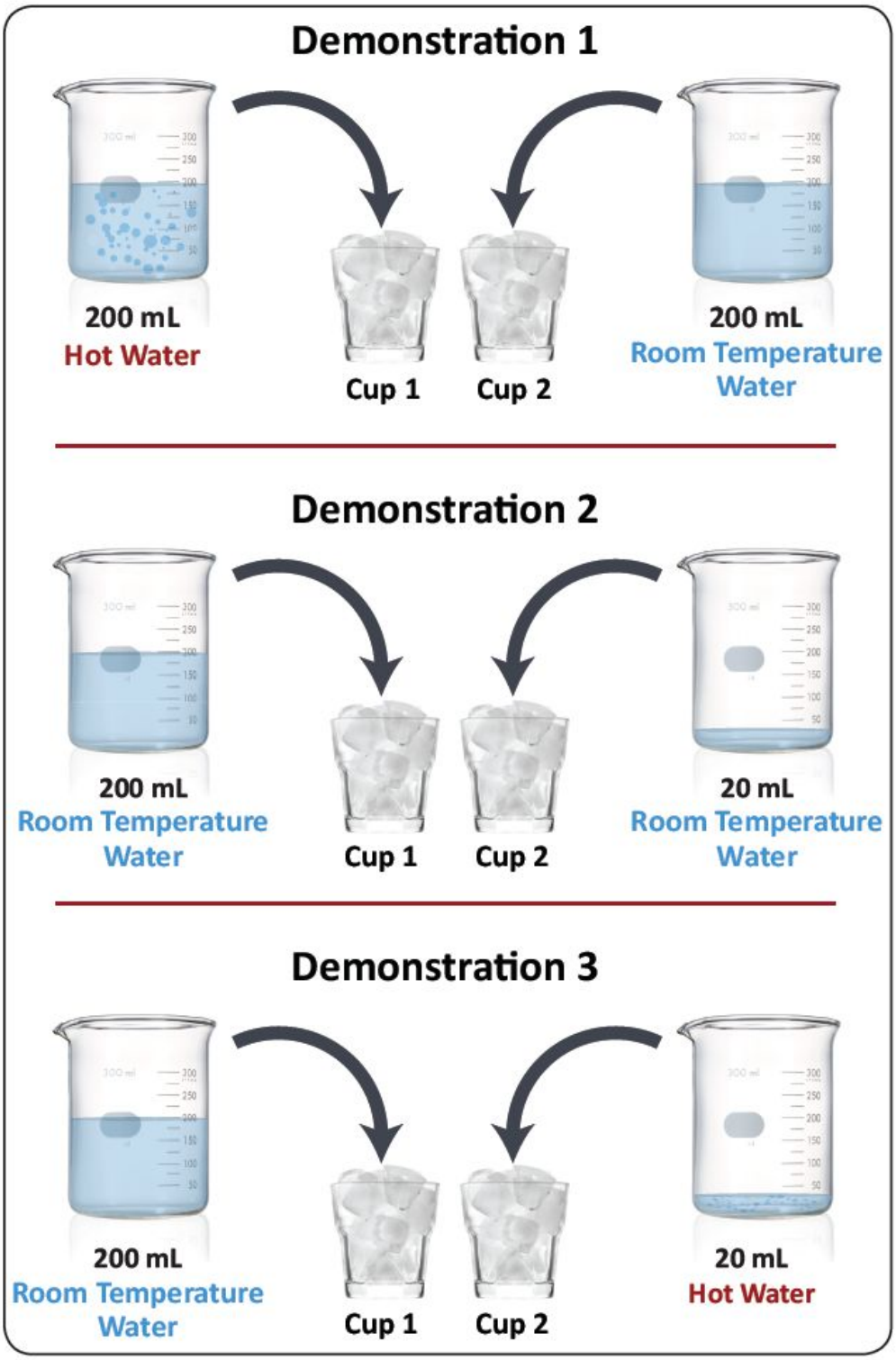


1. Discuss these questions in your group before watching the three demonstrations.
    - Why is it important to keep the amount of ice in the cups the same for all three demonstrations?
    - Why is it important to pour the water in the cups at the same time?
    - Why is it important not to mix the ice in Cup 1 if you do not mix the ice in Cup 2?
2. For each demonstration, make a prediction.
    - Will the ice in Cup 1 or Cup 2 melt faster?
    - Discuss reasons for your predictions.
    - Record your predictions in the Data Table.
3. Watch the demonstration.
4. Fill in the Data Table.
5. Discuss these questions in your group after watching each demonstration.
    - Which cup of ice melted faster?
    - In which cup was there more thermal energy?
    - How do you know?

Compare Thermal Energy and Temperature

LAB

Description of Three Demonstrations

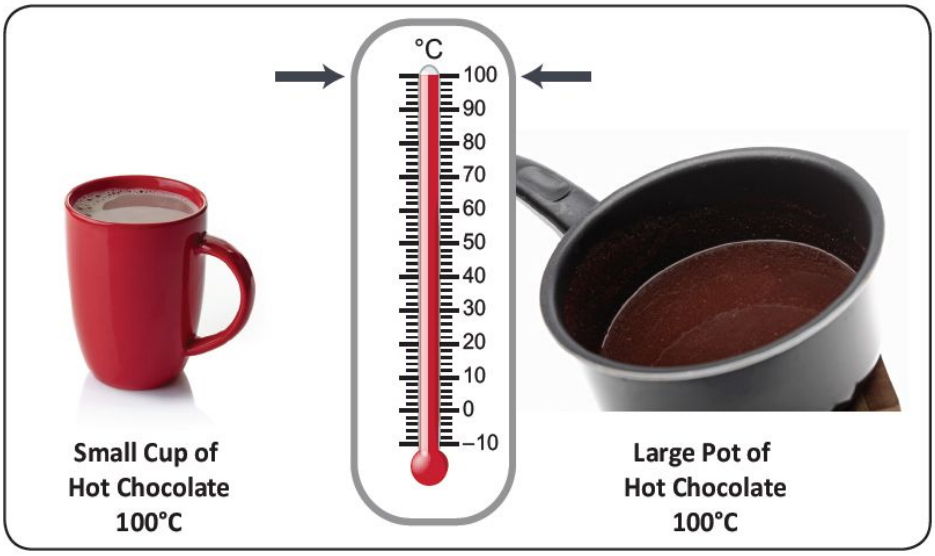


Data Table

	Prediction	Results	Reason
	Which cup of ice will melt faster? (1, 2, or same)	Which cup of ice melted faster? (1, 2, or same)	Explain your results.
Demonstration 1 Cup 1: 200 mL Hot Water Cup 2: 200 mL Room Temperature Water			
Demonstration 2 Cup 1: 200 mL Room Temperature Water Cup 2: 20 mL Room Temperature Water			
Demonstration 3 Cup 1: 200 mL Room Temperature Water Cup 2: 20 mL Hot Water			

6. Answer the following question using evidence from the three ice demonstrations.

Which container of hot chocolate has more thermal energy?



a. Draw two diagrams in your science notebook to represent the **number** and the **movement** of the particles in each container of hot chocolate. An example science notebook setup is shown below.

Small Cup of Hot Chocolate	Large Pot of Hot Chocolate

Compare Thermal Energy and Temperature

b. In your science notebook, construct an argument **supported by evidence** from your ice demonstrations to explain which container of hot chocolate has more thermal energy. Record your group's ideas in the space below, and then record your ideas in your science notebook.

Claim	I think the _____ has more thermal energy.
Evidence	I saw in Demonstration _____ that...
Reasoning	The _____ [large, small] cup has more thermal energy because ... (Use the words *temperature*, *thermal energy*, *kinetic energy*, and *particles* in your reason to explain how the evidence supports your claim.)
Counterclaim	Others think _____ has more thermal energy.
Refute the Counterclaim	I disagree because _____.

b. In your science notebook, create an energy map using the energy vocabulary words.

Part III • Connect to the Culminating Project and Assessment

Complete the individual Project Organizer for this task.