Student Version

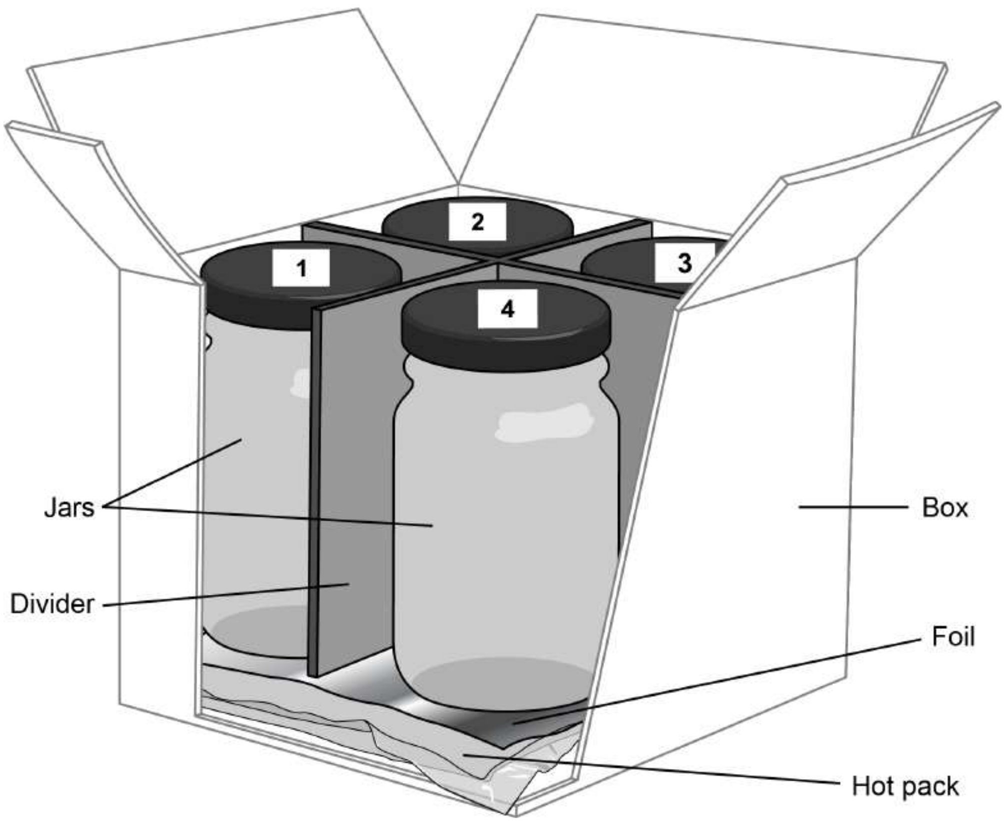
Delaware Science Assessment Prototype: Grade 8 Integrative Item Cluster

Prepared for the Delaware Department of Education
by WestEd

Hot Pack Investigation #1

A student investigated how volume affects how the temperature of a substance changes by following these steps:

- Place an instant hot pack in the bottom of a cardboard box.
- Put a layer of aluminum foil on top of the hot pack.
- Place a tight-fitting cardboard divider in the box on top of the foil to create four sections.
- Add a different volume of room temperature water to each jar.
- Place one jar in each section, as shown in the diagram below.



The cardboard box was sealed and the water was allowed to heat for 10 minutes. After 10 minutes, the student removed the four jars and immediately recorded the temperature of the water in each jar.

Question 1. In the space below, make a prediction to answer these two scientific questions:

1. How will thermal energy be transferred between the instant hot pack and the water in each jar?
2. How will the temperature of the water in each jar change during the 10 minutes the box is sealed?

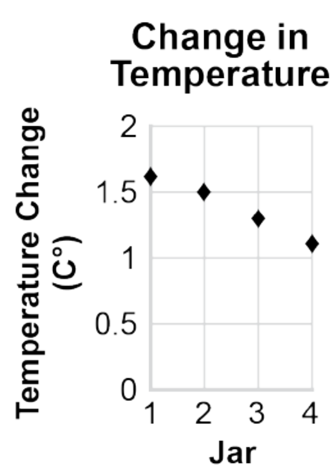
Write one or two sentences. It is **not** important for your prediction to be correct. You will explain whether or not your prediction is supported later.

I predict that, over time:

Data from the student's experiment are shown in the table and graph below. Think about the prediction you made as you look over these data.

Volume and Temperature Data

	Jar 1	Jar 2	Jar 3	Jar 4
Volume (mL)	100	125	150	175
Starting Temp. (°C)	22.3	22.3	22.3	22.3
Ending Temp. (°C)	23.9	23.8	23.4	23.4
Temp. Change (°C)	1.6	1.5	1.3	1.1



Question 2.

Part A
Does the data in the graph support the prediction you made in Question 1?

Circle one:	**Yes**	**No**

Part B
Explain how the data support or do not support your prediction. Use data from the graph and/or table to support your explanation.

Hot Pack Investigation #2

The student collects the data shown in the table before and after using an instant hot pack on his arm.

Instant Hot Pack Data

	Before Using	**After Using**
Mass of Instant Hot Pack	300 g	300 g
Temperature of Instant Hot Pack	45°C	15°C
Temperature of Arm	30°C	35°C
Temperature of Room	20°C	20°C

Question 3. Which statements support the student's claim that the matter and energy of the instant hot pack are conserved even though the temperature of the instant hot pack changed?

Select the **two** correct statements.

A. The mass of the instant hot pack did not change because the same amount of matter was present.

B. The mass of the instant hot pack did not change because the total amount of energy was conserved.

C. Matter was conserved because it flowed from the hot pack to the arm, as shown by the temperature data.

D. Energy was conserved because it flowed from the instant hot pack into the arm causing the arm to warm, as shown by the temperature data.

E. The instant hot pack transferred energy as cold flowed from the arm into the hot pack and changed the temperature of the arm, until both were at the same temperature.

Hot Pack Investigation #3

The student wants to test how the ratio between the mass of a hot pack and the mass of a water sample relates to temperature change. The student designs the procedure shown below.

Student's Procedure

1. Place a beaker with 50 mL of room-temperature water on top of a 300-g hot pack.
2. Place a beaker with 100 mL of room-temperature water on top of a 600-g hot pack.

The student realizes he must redesign his procedure before conducting the test.

Question 4. Explain how the student should redesign the procedure to test how the ratio between the mass of a hot pack and the mass of a water sample relates to temperature change. Use what you know about proportion and quantity to support your explanation.

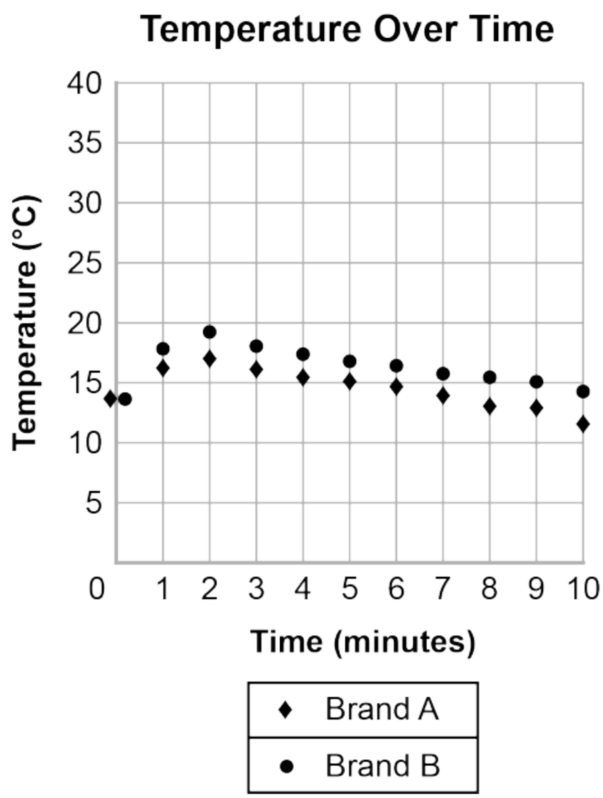
Hot Pack Investigation #4

The student notices that the ratio of salt to water is different in different brands of hot packs. The student tests two different brands of hot packs to see how this ratio affects the temperature of the hot pack over time. The student places two different hot packs on two identical metal benches outside on a cool day and records the temperature of each hot pack each minute for ten minutes.

The student's data are shown below.

Hot Pack Brands Data

Hot Pack Brand	Mass of Salt (in g)	Volume of Water (in mL)
A	75.0	300
B	100.0	300



Question 5.

Part A
Which claim is **best** supported by the students' data?

A. A salt solution with more mass will have a higher temperature than a salt solution with less mass.

B. A salt solution with more water than salt will have a higher temperature than a salt solution with more salt than water.

C. A salt solution with a higher ratio of salt to water will have a higher temperature than a salt solution with a lower ratio of salt to water.

D. A salt solution with a greater total volume of salt and water will have a higher temperature than a salt solution with a smaller total volume of salt and water.

Part B
Based on the data, which combinations of salt and water will likely reach a higher temperature than either Brand A or Brand B?

Select the **two** correct answers.

A. 75.0 g of salt and 250 mL of water

B. 100.0 g of salt and 250 mL of water

C. 100.0 g of salt and 400 mL of water

D. 125.0 g of salt and 400 mL of water

E. 150.0 g of salt and 400 mL of water

Question 6. The student looks at the hot packs on the bench and determines the hot packs and the bench can be thought of as two interacting systems. The student wants to model energy flow and average kinetic energy of the particles at different locations as these two systems interact.

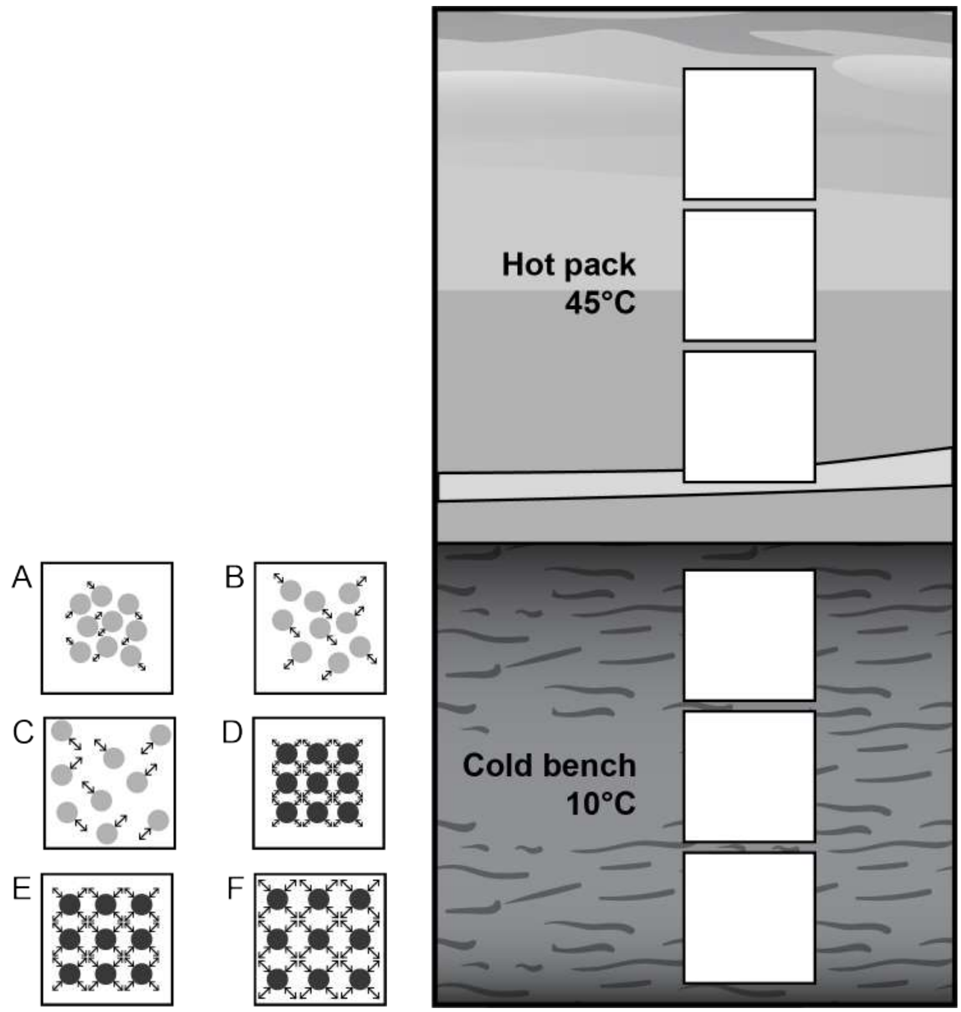
Part A

Follow these steps to complete the students' model:

Step 1: Look at the six particle pictures, labeled A-F, below. Each picture represents the motion of the particles at one location in the model.

Step 2: Write the letter of the picture (A-F) that **best** represents the motion of the particles in each white box on the model. Each letter should only be used **one** time.

Step 3: On the model, draw **one** large arrow to show the direction in which energy is transferred between the hot pack and the cold bench in this system.



Part B

Explain how the kinetic energy of the molecules in the instant hot pack and in the cold bench will change as a result of the heat transfer you modeled in Part A.