Where Heat Goes

Investigate energy transfer in a closed system.

CH.PS3.4 "Plan and conduct an investigation to provide evidence that the transfer of energy between components in a closed system involves changes in energy dispersal and results in a more uniform energy distribution among the components in the..."

NAME _____ DATE _____

1 READ AND MARK

Read it twice

YOUR JOB Underline the system boundary and the steps that limit energy exchange with the room, circle the first and last pairs of temperature readings, and number the statements about energy transfer, more even distribution, and near conservation in that order.

Two Blocks in a Box

1. A science team wants to track energy transfer without losing track of where the energy goes. They place two identical aluminum blocks in a tightly closed, well-insulated box. One block begins at 60 °C and the other at 20 °C. A thin metal strip connects them, and temperature probes touch each block. The probes pass through sealed openings so the lid stays shut. The system includes both blocks, the strip, and the air inside the box. Because no matter enters or leaves, it is a closed system. Insulation limits energy exchange with the room but does not make that exchange impossible.

2. The team records both temperatures every two minutes without opening the lid. At the start, the readings are 60 °C and 20 °C. Later they read 52 °C and 28 °C, then 44 °C and 36 °C, and finally 41 °C and 39 °C. The hotter block cools as the cooler block warms. Energy moves through the strip and also through the air. Since the blocks have the same mass and material, a similar change in temperature indicates a similar change in thermal energy in each block. The strip and air can gain or lose energy too.

3. The temperature gap shrinks from 40 °C to 2 °C, evidence that thermal energy has become more evenly distributed among the blocks. Energy has not vanished when the hot block cools. It spreads into cooler components; if the insulation works well, the system's total energy remains nearly constant. To strengthen the claim, the team repeats the trial and checks whether the readings follow the same pattern. They also measure room temperature and test the box for heat leaks. Any noticeable exchange with the room would weaken a claim that the measured system conserved energy exactly.

2 ANSWER WITH EVIDENCE

Use the passage

1. How does the team's setup let them measure energy transfer while limiting exchange with the room?

2. Calculate the temperature gap at the start and at the final reading. What does the change show about energy distribution between the blocks?

3. Compare each block's temperature change from the first to the final reading. What does this suggest about energy conservation, and what other component could store energy?

4. How would a heat leak affect the team's claim about the system's total energy? Name one check from the passage that could help them investigate a leak.

3 YOUR TURN

Your own words

Design an investigation using a sealed bag of cool water inside a sealed, insulated container of warmer water. In one paragraph, identify the system boundary, explain how and when you will measure temperatures without opening the container, predict the temperature pattern, and describe evidence for both a more uniform energy distribution and approximate conservation of total energy.

ANSWER KEY

Where Heat Goes

HIGH SCHOOL · CH.PS3.4

PART 1 · READ AND MARK

Underline the system boundary and the steps that limit energy exchange with the room, circle the first and last pairs of temperature readings, and number the statements about energy transfer, more even distribution, and near conservation in that order. Accept any marking that follows this job and points at the right text.

PART 2 · ANSWERS

#	QUESTION	ANSWER
1	How does the team's setup let them measure energy transfer while limiting exchange with the room?	**The probes record both blocks' temperatures without opening the sealed box, and insulation limits energy exchange with the room.**
2	Calculate the temperature gap at the start and at the final reading. What does the change show about energy distribution between the blocks?	**The gap decreases from 40 °C to 2 °C, showing that the blocks' thermal energy has become more evenly distributed.**
3	Compare each block's temperature change from the first to the final reading. What does this suggest about energy conservation, and what other component could store energy?	**The hot block cools by 19 °C, and the cool block warms by 19 °C. Their equal masses and material suggest similar thermal energy changes in opposite directions. The strip or air could also store energy.**
4	How would a heat leak affect the team's claim about the system's total energy? Name one check from the passage that could help them investigate a leak.	**A leak would allow energy to cross the system boundary, so its total energy might not remain constant. The team can test the box for heat leaks.**

PART 3 · YOUR TURN (SAMPLE ANSWER)

I would put 100 mL of cool water in a sealed plastic bag and suspend it in 100 mL of warmer water inside an insulated, sealed jar. The system boundary surrounds the jar and everything inside it. Two probes passing through sealed openings would record each water temperature every minute for 15 minutes without lifting the lid. I predict the warm water will cool and the cool water will warm until their temperatures nearly match. Similar temperature changes in equal water masses would suggest that energy lost by one mostly enters the other; small transfers to the bag and jar must also be considered.

Accept plans that measure both components over time without opening the container and use converging temperatures as evidence of energy dispersal. Conservation claims should account for energy stored by other components and possible exchange with the room.