

Heat on the Move

Read evidence of fair heat-transfer investigations.

S8P2.d "Plan and carry out investigations on the effects of heat transfer on molecular motion as it relates to the collision of atoms (conduction), through space (radiation), or in currents in a liquid or a gas (convection)."

NAME _____

DATE _____

1 READ AND MARK _____ Read it twice

YOUR JOB Circle each heat-transfer method named in the passage. Underline the details that show what investigators keep the same, change, or measure, so you can identify a fair test.

Testing How Heat Travels

- ① During a conduction investigation, students place one end of a metal spoon in warm water while the other end rests outside the cup. Heat enters the spoon near the water. Atoms there vibrate faster and collide with nearby atoms, passing energy along the metal. To make a fair test, they use equal spoon lengths, the same water amount, and the same heating time. They record the temperature at the far end every minute with a thermometer and note when it warms.
- ② For a radiation investigation, a student aims a heat lamp at identical dark cans of water. One can stands 10 centimeters from the lamp, and another stands 30 centimeters away. Radiation is energy carried by electromagnetic waves, so it can move through the air and even through empty space. The nearer can usually warms faster because it receives more radiation. As water molecules gain energy, they move faster. Keep the can size, water volume, lamp setting, and heating time the same. Measure each can's temperature before and after heating.
- ③ Convection can be tested in a clear container of water warmed gently at one side. Water near the heat gains energy, so its molecules move faster and spread farther apart. This warmer water becomes less dense and rises. Cooler, denser water sinks to replace it, forming a current. A drop of food coloring can help show the moving water. For a fair test, students keep the container, water volume, heat source, and starting temperature the same, then record the dye's path at set times.

2 ANSWER WITH EVIDENCE Use the passage

- 1 In the spoon investigation, how does thermal energy reach the far end of the spoon? Include what the atoms do.

- 2 Name two factors the students keep the same in the spoon investigation. Why do they keep these factors the same?

- 3 What variable changes in the radiation investigation, and what measurement shows the effect of that change?

- 4 Why does the warmed water rise in the convection investigation, and what observation can reveal the current?

3 YOUR TURN

Your own words

Plan and carry out a conduction test. Teacher supplies two identical metal spoons, identical cups, room-temperature water and warm water no hotter than 40 °C, two probe thermometers, timer and labels. Teacher handles and checks water; no lamp, flame or boiling water. Use the same water volume and spoon immersion depth.

Plan how to change only water temperature and predict which spoon's dry far end will warm more. With teacher support actually measure both dry far ends before immersion, then at 1, 2 and 3 minutes; keep probe positions the same. Repeat with cooled spoons and fresh water. Record both starting temperatures and every far-end reading in a labeled table on extra paper. Compare the observed changes and explain conduction through vibrating/colliding particles. State that temperature is evidence of energy transfer, not a direct view of atoms; report small or unclear changes honestly.

PART 1 • READ AND MARK

Circle each heat-transfer method named in the passage. Underline the details that show what investigators keep the same, change, or measure, so you can identify a fair test. Accept any marking that follows this job and points at the right text.

PART 2 • ANSWERS

#	QUESTION	ANSWER
1	In the spoon investigation, how does thermal energy reach the far end of the spoon? Include what the atoms do.	Atoms near the warm water vibrate faster and collide with nearby atoms, passing energy along the metal spoon.
2	Name two factors the students keep the same in the spoon investigation. Why do they keep these factors the same?	Answers may name equal spoon lengths, the same water amount, or the same heating time. Keeping them the same makes the test fair.
3	What variable changes in the radiation investigation, and what measurement shows the effect of that change?	The distance of each can from the heat lamp changes. The students compare each can's temperature before and after heating.
4	Why does the warmed water rise in the convection investigation, and what observation can reveal the current?	Warmed water molecules move faster and spread farther apart, making the water less dense so it rises. The path of the food coloring reveals the moving current.

PART 3 • YOUR TURN (SAMPLE ANSWER)

Example plan: Change only the bath temperature while keeping spoons, cups, volumes, immersion depths and probe positions the same. Record both starting bath temperatures and each dry far end at 0, 1, 2 and 3 minutes. Repeat after cooling the spoons.

Illustrative observation, not required results: one trial's far-end readings were 22, 23, 25, 27 °C in the warm-bath spoon and 22, 22, 22, 22 °C in the room-bath spoon. The changes were 5 °C and 0 °C. This supports transfer along the warmer spoon by conduction; particles gain energy and pass it through interactions. Actual bath readings and a second trial must also be recorded. If changes are too small to distinguish, the conclusion must acknowledge that limitation.

Retain all four correct source answers. Teacher provides safe warm water at most 40 °C and probes suitable for contacting the dry metal ends; keep water away from electrical devices. Inspect actual bath temperatures, far-end readings at four times in both trials and an evidence-based comparison linking conduction to particle motion. The illustrative readings are not fixed expected results. Accept inconclusive changes or measurement limits, not invented warming. Only one heat-transfer investigation is required here, not all three; actual carryout and recorded evidence cannot be replaced by a future plan.