

Bridge · Observation, evidence, explanation

Target: Explain a temperature pattern using observations and a scientific idea. Prerequisites: read headings/°C/time, subtract and identify warming/cooling. Follow one sample from its start to finish. An observation describes a supplied reading. Evidence is a relevant observation selected for a question. An explanation connects evidence to a scientific idea.

K4-D-P · H is 100 g of water in a covered cup. All surroundings stay at 23°C. Covered liquid water; no active heating/cooling, ice, phase change, direct sunlight or meaningful evaporative cooling. Room, cup, lid and supporting surfaces are at the stated surrounding temperature; it stays constant. Readings represent the sample temperature with a consistent procedure. This is a paper scenario, not apparatus instructions.

Start and finish of one sample

Constructed teaching data: these values were invented for this activity, not collected in an experiment.

Sample	Start (°C)	After 10 min (°C)
H	13	17

K4-P1. Identify the sample and surroundings, their starting temperatures, the interval and the sample’s change.

K4-P2. Classify these fictional statements: (a) H reads 17°C at 10 min; (b) I use 13 → 17°C to show warming; (c) energy transfers from warmer surroundings toward cooler water. Which adds a scientific explanation?

Vocabulary: sample = the matter being studied; surroundings = parts outside that sample; net = overall transfer after transfers in opposite directions are considered. You may point, speak or draw.

Model · Explain this record

Question: Why did the water’s temperature change during these 15 minutes? We are explaining one pattern, not choosing a winning sleeve.

K4-D-M · One 100 g covered liquid-water sample begins at 12°C. Surroundings stay at 24°C. Covered liquid water; no active heating/cooling, ice, phase change, direct sunlight or meaningful evaporative cooling. Room, cup, lid and supporting surfaces are at the stated surrounding temperature; it stays constant. Readings represent the sample temperature with a consistent procedure. This is a paper scenario, not apparatus instructions.

Supplied water readings from one run

Constructed teaching data: these values were invented for this activity, not collected in an experiment.

Elapsed time (min)	Water (°C)
0	12
5	14
10	16
15	17

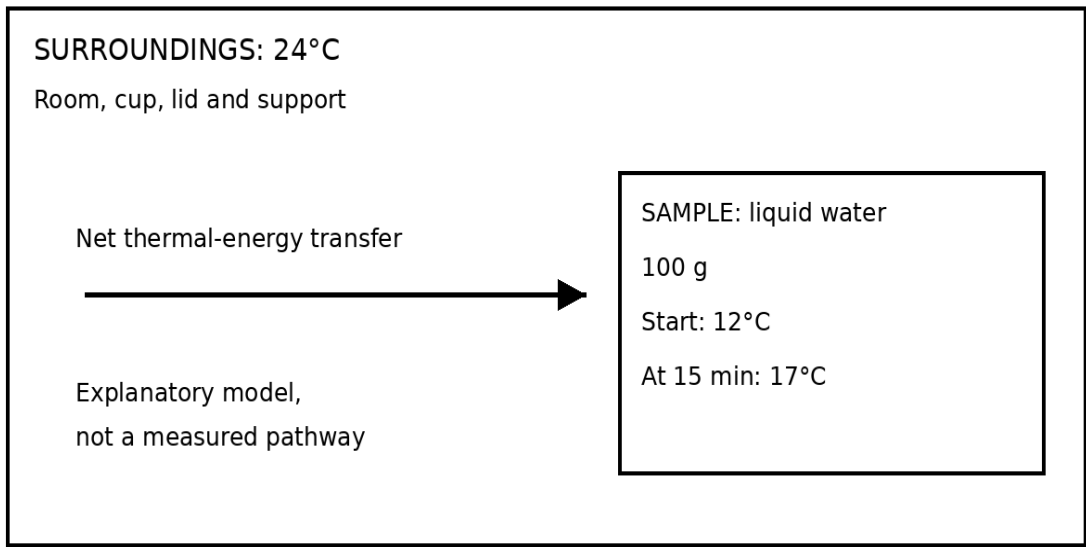
Fictional incomplete response: “It was 12°C at the start and 17°C at 15 minutes. It went up 5°C.”

K4-M1. Which part of this response describes the record? What explanatory connection is still missing?

K4-M2. Use the warmer/cooler parts and net energy transfer to extend the answer. Include a limit.

Model representation · Sample and surroundings

K4-D-M repeated: 100 g water, 12°C start → 17°C at 15 min; all surroundings 24°C. This representation explains the record. Its arrow is a scientific model, not a thermometer observation.



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Outer box: surroundings 24°C, including room, cup, lid and support. Inner box: liquid-water sample, 100 g, 12°C at start and 17°C at 15 min. One arrow points from surroundings toward water and is labeled net thermal-energy transfer. The arrow does not identify a pathway or show particles crossing.

K4-M3. What is observed in the table? What does the representation add? Does it prove that only conduction occurred?

The accompanying text describes every label and arrow. A diagram can show reasoning without a fixed paragraph format.

Guided practice · Explain a different record

K4-D-G · One 100 g water sample begins at 37°C. Covered cup and other surroundings stay at 21°C. Covered liquid water; no active heating/cooling, ice, phase change, direct sunlight or meaningful evaporative cooling. Room, cup, lid and supporting surfaces are at the stated surrounding temperature; it stays constant. Readings represent the sample temperature with a consistent procedure. This is a paper scenario, not apparatus instructions.

One run, not four independent trials

Constructed teaching data: these values were invented for this activity, not collected in an experiment.

Elapsed time (min)	Water (°C)
0	37
5	34
10	32
15	30

K4-G1. Select two relevant readings and describe the size and direction of change.

K4-G2. Name sample/surroundings and the direction of net thermal-energy transfer. Explain how that connects to the readings.

K4-G3. Evaluate the fictional statement “The lower reading means a better sleeve.” What question are we answering, and what cannot this table establish?

Independent task · Explain the record

Use relevant measurements, a scientific connection and a limit. You may write, speak while pointing to data, or draw a labeled representation. This is also the Use a Quick Check task; it is reused, not fresh, after this page has been attempted.

K4-D-I · Three independent trials each use fresh 80 g liquid-water samples in the same covered-cup design. All surroundings stay at 20°C. The 12-minute interval and reading procedure match within/across trials. Covered liquid water; no active heating/cooling, ice, phase change, direct sunlight or meaningful evaporative cooling. Room, cup, lid and supporting surfaces are at the stated surrounding temperature; it stays constant. Readings represent the sample temperature with a consistent procedure. This is a paper scenario, not apparatus instructions.

Initial and final sample readings

Constructed teaching data: these values were invented for this activity, not collected in an experiment.

Trial ID	Start (°C)	After 12 min (°C)
I-1	31	27
I-2	31	26
I-3	31	27

K4-I1. Use at least two trials to describe the temperature pattern and changes.

K4-I2. Explain the pattern. Identify the sample, surroundings, warmer/cooler parts and direction of net thermal-energy transfer.

K4-I3. State one meaningful limit and information or a comparison that would address it. What was observed, and what is part of your explanatory model?

Reteach · Connect evidence to the explanation

K4-D-A ·100 g liquid water in a covered cup;26°C surroundings remain constant. Covered liquid water; no active heating/cooling, ice, phase change, direct sunlight or meaningful evaporative cooling. Room, cup, lid and supporting surfaces are at the stated surrounding temperature; it stays constant. Readings represent the sample temperature with a consistent procedure. This is a paper scenario, not apparatus instructions.

One new record

Constructed teaching data: these values were invented for this activity, not collected in an experiment.

Elapsed time (min)	Water (°C)
0	15
5	18
10	20

Fictional response 1: “It reads 15,18 and 20°C, so it changed.” Fictional response 2: “Energy goes from warmer to cooler, so something changed.”

K4-A1. What does each fictional response supply, and what connection is missing? Point to the evidence you would use.

K4-A2. Connect specific readings to the warmer/cooler parts and net energy transfer. Include what the table does not directly measure.

Optional prompts: What changed? Which part was warmer? In which direction is the net transfer? How is that consistent with the sample's change?

Fresh recheck · Connect a new record

K4-D-Ac · Fresh 90 g covered liquid-water sample; all surroundings stay at 23°C. Covered liquid water; no active heating/cooling, ice, phase change, direct sunlight or meaningful evaporative cooling. Room, cup, lid and supporting surfaces are at the stated surrounding temperature; it stays constant. Readings represent the sample temperature with a consistent procedure. This is a paper scenario, not apparatus instructions.

A different start and interval

Constructed teaching data: these values were invented for this activity, not collected in an experiment.

Sample	Start (°C)	After 8 min (°C)
R	35	31

K4-A3. Explain the change using the sample’s readings, the surrounding temperature and net transfer direction. Add a limit.

This record was not used in the intervention. If it was shown earlier, record that exposure; it is then not a fresh check.

Reteach · Trace energy transfer

K4-D-B · Matched 100 g samples begin at 10°C in 22°C surroundings. Cups/lids,15 min, exposure and procedure match; sleeves are complete designs. Covered liquid water; no active heating/cooling, ice, phase change, direct sunlight or meaningful evaporative cooling. Room, cup, lid and supporting surfaces are at the stated surrounding temperature; it stays constant. Readings represent the sample temperature with a consistent procedure. This is a paper scenario, not apparatus instructions.

One supplied comparison

Constructed teaching data: these values were invented for this activity, not collected in an experiment.

Setup	Start (°C)	After 15 min (°C)
No sleeve	10	18
Sleeve V	10	14

Fictional response 1: “Cold entered through the cup.” Fictional response 2: “Sleeve V made cold.” Fictional response 3: “V stopped all energy transfer.”

K4-B1. For each statement, ask what the speaker means. Which readings and scientific idea would help check it?

K4-B2. Explain V’s change. Draw or describe the net-transfer arrow and revise the stopped-transfer claim. Explain how limiting warming differs from cooling.

Words alone may be imprecise. Show the parts and direction before deciding whether the idea is misunderstood.

Fresh recheck · Trace a new case

K4-D-Bc · Fresh 100 g covered sample with a sleeve in 21°C surroundings. Covered liquid water; no active heating/cooling, ice, phase change, direct sunlight or meaningful evaporative cooling. Room, cup, lid and supporting surfaces are at the stated surrounding temperature; it stays constant. Readings represent the sample temperature with a consistent procedure. This is a paper scenario, not apparatus instructions.

New sample readings

Constructed teaching data: these values were invented for this activity, not collected in an experiment.

Sample	Start (°C)	After 10 min (°C)
Sleeved W	33	29

K4-B3. Explain this temperature change and the direction of net energy transfer. Does the sleeve generate cold or stop all transfer? Use the record and set a limit.

Later check · A changed setting

K4-D-T · A60 g covered liquid-water sample is placed in a chamber whose room/cup/lid/support stay at 19°C. Covered liquid water; no active heating/cooling, ice, phase change, direct sunlight or meaningful evaporative cooling. Room, cup, lid and supporting surfaces are at the stated surrounding temperature; it stays constant. Readings represent the sample temperature with a consistent procedure. This is a paper scenario, not apparatus instructions.

One chamber record

Constructed teaching data: these values were invented for this activity, not collected in an experiment.

Elapsed time (min)	Liquid water (°C)
0	9
6	12
12	14

K4-T1. Explain the pattern using readings, sample/surroundings and net-transfer direction. State what this table cannot prove.

This is a paper task. No chamber or water handling is required.

Later check · Idealized equal temperatures

K4-D-E · Conceptual case: liquid water, cup/lid/support and room are uniformly and exactly 22°C and remain so. The water is in thermal contact with its surroundings. No active source, phase change, evaporation or other energy input/output. These idealized conditions are stipulated, not inferred from readings.

Given conditions, not an experiment

Constructed teaching data: these values were invented for this activity, not collected in an experiment.

Idealized case	Water (°C)	All surroundings (°C)
Uniform temperatures throughout	22	22

K4-T2. Under these idealized conditions, is there net thermal-energy transfer due to a temperature difference? Explain. Does your answer mean particles stop moving?

K4-T3. In another scenario, one water reading is unchanged at 22°C. Does that alone establish thermal equilibrium? Name what else you would need to know.