

Prerequisite mini-lesson · Read before comparing

Question: What do the headings and numbers tell us before we explain a result? A temperature is a reading in degrees Celsius (°C). A temperature change compares two readings from the same setup. A higher final value than the start means warming; a lower one means cooling.

For a fair design comparison, check that starts, water mass, elapsed time, room conditions, and measurement method match. Compare the same points in time. Repeated trials give more than one chance to see a pattern; do not choose only a convenient row.

Data P · Three separate water samples in one 22°C room. Each has 100 g of water and the same cup, lid, and measurement method. The labels W, X, and Y name samples, not sleeve designs.

Temperatures at the start and after 15 minutes

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

Trial	Start (°C)	After 15 min (°C)
W	12	16
X	12	15
Y	12	17

P1. Point to the heading that names the measured quantity and unit. What does the 15-minute column mean?

P2. How much did W, X, and Y change? Say whether each warmed or cooled.

P3. If another sample started at 30°C and ended at 26°C after 15 minutes, did it warm or cool, and by how much?

P4. Why would a 10-minute result from a different starting temperature be a weak direct comparison with X?

Support: Trace start → finish with a finger or number line. You may explain aloud or use a labeled arrow instead of a paragraph.

Teacher model · Which sleeve slowed warming?

Question: Which complete sleeve design better limited warming of cool water in this 20-minute comparison?

Data M · One illustrative trial. Equal 100 g water samples begin at 10°C in a 22°C room. Matching cups and lids, exposure time, and thermometer procedure are stated. No ice, active cooling, or direct sunlight is involved. The sleeve designs differ.

Water temperature over 20 minutes

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

Time (min)	No sleeve (°C)	Sleeve A (°C)	Sleeve B (°C)
0	10	10	10
5	14	11	12
10	17	12	14
15	19	13	15
20	20	14	16

M1. What is measured? Give two observations without explaining the cause.

M2. Find the 0-to-20-minute temperature change for all three setups.

M3. Which sleeve is better supported? Compare it with the other sleeve and with no sleeve at the same time.

M4. A fictional student says, ‘Sleeve A stopped all energy transfer because its water stayed colder.’ Which part is supported? What must change?

M5. Explain the direction of net thermal-energy transfer and name one conclusion this record cannot establish.

Guided practice · Check every trial

Question: In these repeated comparisons, which sleeve is better supported for limiting warming?

Data G · Three separate trials with fresh 100 g water samples, each starting at 10°C in a 22°C room. Cups, lids, 20-minute exposure, and thermometer procedure match. Each row compares setups tested under the same stated conditions.

Final water temperatures after 20 minutes

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

Trial	No sleeve: final °C	Sleeve L: final °C	Sleeve N: final °C
1	20	16	17
2	21	17	18
3	20	16	17

G1. In Trial 1, how much did L and N warm? Which comparison is relevant?

G2. Look at Trials 2 and 3. Does the same design have less warming in each? Cite the matched pairs.

G3. Make a claim for these conditions. Include one limit. Does the table prove which heat-transfer pathway caused the result?

Independent task · Choose from new results

Work on this record without returning to the model's design choice. You may show your thinking in prose, a labeled diagram, or an oral explanation that points to data.

Data I · Three separate trials use fresh 100 g samples starting at 11°C in a 23°C room. Cups, lids, exposure, 20-minute duration, and thermometer procedure match within and across trials. The table shows final readings, not a time series.

Final water temperatures after 20 minutes

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

Trial	No sleeve: final °C	Sleeve C: final °C	Sleeve D: final °C
1	21	18	16
2	20	17	15
3	21	18	16

I1. Which sleeve is better supported for limiting warming under these conditions? Use at least two matched D-versus-C comparisons.

I2. What differs across the trials, and what pattern stays consistent? You may compare rows directly; a mean is not required.

I3. Explain why the water changed temperature and how the evidence supports your choice. State the direction of net energy transfer.

I4. A fictional student says, ‘Sleeve D cooled the water.’ Agree, disagree, or revise using the starting and final readings.

I5. State one useful conclusion and one question these records do not settle. Name information or a test that addresses that question.

Reteach · Compare the measurements

Read one setup from start to finish before comparing designs. Write 'start → final'; then decide whether the value rose or fell.

Data R · Two separate trials. Fresh 100 g water samples start at 12°C in a 24°C room. Cups, lids, 15-minute exposure, and measurement procedure match. Each row compares sleeves X and Y.

Final water temperatures after 15 minutes

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

Trial	Start (°C)	Sleeve X: final °C	Sleeve Y: final °C
1	12	15	18
2	12	16	18

R1. Did either design cool its water? For each trial, write X: start → final → change and Y: start → final → change.

R2. Which sleeve showed less warming in both trials? Explain why the smallest final value works here.

Fresh check · The goal now is to limit cooling. Fresh 100 g water samples begin at 34°C in a 22°C room. Two 20-minute trials use matching cups, lids, and measurement methods.

Final water temperatures after 20 minutes

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

Trial	Start (°C)	Sleeve P: final °C	Sleeve Q: final °C
1	34	29	31
2	34	28	30

R3. Which sleeve better limits cooling? Give both temperature drops. Is the lowest endpoint the best choice for this goal?

Reteach · Use all results and limit the claim

Question: Do these results support a clear winner, or a narrower statement? Read all rows before choosing evidence.

Data F · Four separate matched trials. Fresh 100 g water samples start at 10.0°C in a 22°C room. Cups, lids, 20-minute exposure, and thermometer procedure match. Readings are displayed to 0.1°C; instrument accuracy is not supplied.

Final water temperatures after 20 minutes

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

Trial	Sleeve J: final °C	Sleeve K: final °C
1	14.0	14.5
2	15.0	14.5
3	15.0	14.5
4	15.0	14.5

Fictional response 1 — selected only favorable evidence: ‘J wins because Trial 1 ends at 14.0°C for J and 14.5°C for K.’

Fictional response 2 — overstates the record: ‘K is proven best for every room and every future trial because it is lower in Trials 2–4.’

F1. For each trial, identify which sleeve has the lower endpoint. What would you miss by quoting only Trial 1?

F2. Evaluate each fictional response. Which observation is accurate, and which conclusion goes beyond the record?

F3. Write a claim that uses the full record and states the uncertainty. What would strengthen a preference?

New short check · Apply the correction

Data F-check uses fresh 100 g samples starting at 11°C in a 23°C room. Cups, lids, 20-minute exposure, and thermometer method match within and across three separate trials.

Final water temperatures after 20 minutes

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

Trial	Sleeve R: final °C	Sleeve S: final °C
1	16	15
2	16	17
3	16	17

F4. Which design has the lower endpoint in each trial? Revise ‘S is always better’ into a claim the complete record supports.

Later check · Reverse the direction

Question: Which sleeve better limits cooling when water begins warmer than the room? This is a paper-data task, not a hot-water activity.

Data T · Three separate matched trials use fresh 100 g samples starting at 40°C in a 22°C room. Matching cups, lids, 20-minute exposure, and thermometer procedure are stated.

Final water temperatures after 20 minutes

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

Trial	No sleeve: final °C	Sleeve P: final °C	Sleeve Q: final °C
1	28	32	36
2	29	33	35
3	28	32	36

T1. Find the temperature drop for each design in at least two trials. Which sleeve better limits cooling across the record?

T2. Explain the direction of net thermal-energy transfer. Why is ‘choose the lowest final temperature’ a poor rule for this goal?

T3. State a bounded conclusion and one unanswered question. What new information or test would help?