Teacher quick start · Which Design Is Better Supported?

Learning target: Compare matched results across trials, support a design choice with relevant evidence, and limit the claim to tested conditions. Intended for Grade 6; related NGSS expectations span Grades 6–8. This is a paper-and-pencil, supplied-data lesson.

Prerequisites: read a small table, subtract whole-number temperatures, recognize °C, and understand start versus finish. Teach the included prerequisite bridge first. No earlier kit or equipment is required. Calculator, number line, pointing, oral response, and projection are optional.

Print menu

Teach the Lesson → Student tasks/Teach the Lesson (PDF) (Prerequisite bridge, Teacher model, Guided practice, Independent task). Use teacher sections Prerequisite bridge, Teacher model, Guided practice, Independent task.

Use a Quick Check → Student tasks/Use a Quick Check (PDF) (independent task only). This is an alternate print route for the same independent task in Teach the Lesson, not a new check after using Independent task. Use teacher section Independent task; choose Later check · Reverse the direction later if The independent task was already seen.

Reteach: Compare the Measurements → Student tasks/Which Design Is Better Supported?--Reteach Compare the Measurements (PDF) (R including fresh check). Use teacher Recording and response notes.

Reteach: Use All Results and Limit the Claim → Student tasks/Which Design Is Better Supported?--Reteach Use All Results and Limit the Claim (PDF) (F including fresh check). Use teacher Use all results.

Use a Later Check → Student tasks/Use a Later Check (PDF) (T only). Use teacher section Later check.

Suggested sequence and next decision

Planning estimate, not tested timing: Prerequisite bridge 8–10 min; Teacher model 10–12; Guided practice 8–10; Independent task 10–12 (about 36–44 min total). A reteach is estimated at 10–15 min; a later check at 5–8 min. Use the prerequisite bridge to check readiness, Model, prompt guided practice, then collect the independent response without modeling its answer.

Notice separately: reading/calculation, matched comparison across trials, science connection, and appropriate limit. If the response is blank or unclear, first check access to the table, language, and response mode; invite pointing, a labeled diagram, or oral explanation. Then choose Compare the Measurements for reading/change/direction errors, or Use All Results and Limit the Claim for single-row evidence or an overbroad claim. A correct choice with no explanation calls for a question before a reteach decision.

Data status: every table is constructed teaching data, invented for instruction. It is not experimental evidence about real products. Keep the disclosure with every print selection. The student packet contains no keys.

Prerequisite teaching and key

Say: ‘The heading tells what was measured and the unit. I follow one sample from start to finish. W goes from 12°C to 16°C, so it warmed by 4°C. I do not compare a 15-minute finish to a 10-minute finish as though they had the same time to change. If one result is unusual, I keep it and compare the whole record.’ Point to columns as you speak.

Prerequisite bridge data · constructed teaching data

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

Prerequisite mini-lesson · Read before comparing, question 1 key: The start and after-15-minutes headings give temperature in °C; the latter is the reading after 15 minutes, not a 15°C change. Prerequisite mini-lesson · Read before comparing, question 2: W +4°C, X +3°C, Y +5°C; all warmed. Prerequisite mini-lesson · Read before comparing, question 3: 30→26°C is cooling by 4°C. Prerequisite mini-lesson · Read before comparing, question 4: starting temperature and elapsed time differ; those differences can affect the measured change, so it is not a like-for-like direct comparison.

Readiness decision: If the learner finds units, time, direction, and at least two changes with a prompt, proceed and keep a number line available. If the learner reverses direction or mixes rows, trace one row and have them solve a new one before the Model. If arithmetic alone is hard, allow a number line or subtraction support while preserving the comparison target. Do not infer a science difficulty from an unreadable or blank answer before clarifying access.

Science note: A Celsius reading is temperature, not total stored energy. Do not compare total energy by simply comparing Celsius numbers. Start-to-finish change is reported in °C here; no joule calculation is needed.

Complete Model

Question and setup: Which complete sleeve design limits warming of equal 100 g cool-water samples during one 20-minute comparison? The 22°C room is warmer than the 10°C water; cups, lids, exposure, and measurement procedure match. Sleeve design is the difference. The table does not isolate a material property or a specific heat-transfer pathway.

Teacher model data · constructed teaching data

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

Think-aloud: ‘I read the time and unit first. All three begin at 10°C. At 20 minutes, no sleeve is 20°C, A is 14°C, and B is 16°C. I subtract the same start from each final reading: +10°C, +4°C, and +6°C. A warms 2°C less than B and 6°C less than no sleeve in this one comparison. I use “limits warming,” since A still warms. I keep the claim to this setup and duration.’

Teacher model · Which sleeve slowed warming?, question 1 key: Water temperature in °C. Accept any two exact observations, such as all start at 10°C and A reads 13°C at 15 minutes. Teacher model · Which sleeve slowed warming?, question 2: no sleeve +10°C; A +4°C; B +6°C. Teacher model · Which sleeve slowed warming?, question 3: A is better supported for this trial; matched 20-minute readings or changes and both comparators should appear. Because starts match, endpoints are an acceptable way to compare.

Teacher model · Which sleeve slowed warming?, question 4: A stayed cooler than B at the end, but it did not stop transfer; its water rose from 10°C to 14°C. Say it limited warming relative to B and no sleeve. Teacher model · Which sleeve slowed warming?, question 5: In this passive setup, net thermal-energy transfer is from warmer surroundings toward cooler water. Smaller warming of equal water masses is consistent with less net energy entering A's water over the interval. The thermometer did not separately measure conduction, convection, or radiation. The one constructed trial cannot establish universal or real-world performance, a particular mechanism, or longer-term performance.

Teacher move: If a student says ‘cold escaped,’ ask which part is warmer and point an arrow for net transfer. If they say ‘stopped heat,’ return to A's 10→14°C rise. Accept an oral explanation or labeled arrow with accurate data. Do not award reasoning simply for a paragraph heading or the word ‘because.’

Guided practice and moves

Ask, without naming a winner: ‘Where do you see the same start and interval? Compare L with N in Trial 1. Does the direction of that comparison hold in the other rows? What does the room temperature suggest about net energy transfer?’

Guided practice data · constructed teaching data

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

Guided practice · Check every trial, question 1 key: L warms 6°C and N 7°C in Trial 1, so L warms 1°C less. Guided practice · Check every trial, question 2: Trial 2 L 17°C versus N 18°C; Trial 3 L 16°C versus N 17°C. L is lower by 1°C in every row. No-sleeve readings are 20, 21, 20°C and show both sleeves limited warming relative to that comparator. Guided practice · Check every trial, question 3: L is better supported in these stated trials. All samples warm as net energy transfer is toward the cooler water; the record does not prove a particular pathway, universal performance, or a reliable magnitude in other conditions.

Anticipated ‘N is better because 18 is a bigger number’: ask which direction meets the goal and compare 10→17 with 10→18. ‘L always wins’: underline the stated 22°C room and 20-minute interval; ask for a bounded sentence. ‘Trial 1 is enough’: cover then reveal the other rows; ask whether each pair agrees. ‘No-sleeve proves material L is best’: clarify that the table compares complete designs and does not isolate a material property.

Accept calculations or direct matched endpoints because starts are equal. If a learner correctly chooses L but gives no evidence, ask them to point to two rows and say what each comparison shows. Avoid treating lack of written fluency as lack of science understanding.

Independent task key and response guide

Independent task data · constructed teaching data

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

Independent task · Choose from new results, question 1: D is better supported under these conditions. Trial 1: D 16°C versus C 18°C; Trial 2: D 15°C versus C 17°C; Trial 3 gives 16°C versus 18°C. Both start at 11°C; D warms 2°C less than C in each row. No-sleeve comparison may strengthen, but must not replace, D-versus-C evidence.

Independent task · Choose from new results, question 2: No sleeve rises 10, 9, 10°C; C rises 7, 6, 7°C; D rises 5, 4, 5°C. Trial 2 endpoints are 1°C lower across the setups, while D is 2°C lower than C in every row. Do not invent a cause for Trial 2. Independent task · Choose from new results, question 3: Room 23°C exceeds start 11°C, so net energy transfer is toward the water; all warm. D's smaller warming is consistent with greater thermal protection under the stated conditions. Exact pathway is not measured.

Independent task · Choose from new results, question 4: ‘Cooled’ is false: D ends at 15–16°C, above 11°C. It limits warming. Independent task · Choose from new results, question 5: Accept a specific conclusion restricted to these constructed 20-minute comparisons and a meaningful unanswered question, such as other room temperatures, longer times, different water masses, instrument accuracy, or actual materials. An additional test or information source must address the named limit. Constructed data cannot establish real-world product performance.

Response decisions: For reversed subtraction, mixed rows, or ‘cooled,’ use Compare the Measurements. For citing only one favorable row or saying ‘always,’ use Use All Results and Limit the Claim. For a correct D choice without an explanation, first ask ‘Which two rows support that?’ If the response is unclear, verify task and table access and invite an oral or diagram response before assigning content support. Note reading, comparison, science link, and limits separately; this is a teaching record, not a validated score.

Reteach: compare the measurements

Intervention: Draw a short number line. Model Trial 1 X as 12→15°C: final exceeds start, so +3°C warming. Have the learner trace Y 12→18°C and say +6°C warming. Ask for Trial 2 independently. Then switch the goal in fresh check Compare the measurements, question 3 to see whether they follow the question instead of choosing the smallest endpoint.

Student data R · constructed teaching data

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

Compare the measurements, question 1: Trial 1 X +3°C, Y +6°C; Trial 2 X +4°C, Y +6°C. Neither cooled. Compare the measurements, question 2: X shows less warming in both matched trials. Its lower final reading is relevant because starts, mass, interval, and stated conditions match. A lower endpoint is not a universal rule for every goal.

Student fresh-check data R-check · constructed teaching data

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

Compare the measurements, question 3: P drops 5°C and 6°C; Q drops 3°C and 4°C. Q better limits cooling in both trials. The lowest endpoint would select P and would conflict with the goal. The 34°C water is warmer than the 22°C room, so net transfer is outward. If direction remains reversed, revisit start→final using a number line; if direction is sound but a full-record claim is missing, use Use All Results and Limit the Claim.

Reteach: full record and bounded claims

Think-aloud: ‘Trial 1 favors J by 0.5°C. I keep reading. Trials 2, 3, and 4 favor K by 0.5°C each. I can report that pattern, but accuracy is not supplied and the differences are small. I will not call either design proven best everywhere. I would check the instrument and repeat matched tests before making a stronger preference.’

Student data F · constructed teaching data

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

Use all results and limit the claim, question 1: J has the lower endpoint in Trial 1; K in Trials 2–4. Quoting only Trial 1 hides the later direction. Use all results and limit the claim, question 2: Response 1 accurately describes Trial 1 but its ‘J wins’ conclusion ignores three rows. Response 2 accurately notes K's lower readings in three rows but ‘proven best for every room and future trial’ exceeds four constructed trials, and the record includes one contrary row. Use all results and limit the claim, question 3: Accept: ‘K had lower endpoints in three of four matched constructed trials under these conditions, while J was lower in one. The small differences and unknown accuracy do not justify a confident general preference.’ A cautious preference for K in this record is defensible if it explicitly acknowledges the contrary row, small difference, and uncertainty. Do not mark that as wrong merely because the key uses ‘no confident general preference.’

For a stronger claim, seek instrument accuracy/calibration information, additional independent matched trials, consistent procedure and raw readings, and tests under the specific new conditions being claimed. More trials alone cannot remove systematic measurement bias. Do not discard Trial 1 simply because it conflicts.

Student fresh-check data F-check · constructed teaching data

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

Use all results and limit the claim, question 4: S is lower in Trial 1 (15 versus 16°C); R is lower in Trials 2 and 3 (16 versus 17°C). Accept: ‘R was lower in two of these three constructed trials, while S was lower in one; these results do not show S is always better.’ A cautious R preference for these conditions is acceptable if qualified. No instrument accuracy is specified, and a few small differences do not guarantee a reliable difference. Ask for the full record before declaring a winner.

Later check and interpretation

Later check data · constructed teaching data

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

Later check · Reverse the direction, question 1: Trial 1 falls: no sleeve 12°C, P 8°C, Q 4°C. Trial 2: 11°C, 7°C, 5°C. Trial 3 repeats Trial 1. Q better limits cooling across all three rows. Later check · Reverse the direction, question 2: Water begins at 40°C and room is 22°C, so net transfer is from warmer water toward cooler surroundings. Lowest endpoint would favor the design losing more temperature, which conflicts with the goal. A sleeve can slow transfer, not prove that it stops it.

Later check · Reverse the direction, question 3: Accept: ‘Q showed the least cooling in these three 20-minute constructed comparisons’ plus a relevant limit and addressing test, such as a longer interval, another room temperature, or actual construction. These records do not prove actual product performance or a specific heat-transfer pathway.

Interpretation: An accurate response shows the learner can apply the comparison idea to a reversed temperature direction in this particular task. It does not prove mastery, the durability of learning, real-device performance, or equivalence between this check and the independent task. If the response is unclear, clarify access and response mode before using it to choose a reteach.

Select response practice and keep its check separate

The current preparation menu supplies Compare the measurements as response-practice files, with each Fresh check in a separate reserved file. Use only the practice selection while explaining and practicing. Then give the matching reserved fresh-check file, retaining the original question numbers so the matching answer guidance still applies. Keep the separate later task for a different occasion. The earlier combined sheets are historical; do not distribute them during response teaching.

A different prompt is not a validated equivalent test. Record which materials and access route were used, and clarify unclear wording or access before choosing further teaching.

Fictional teaching response — sound for the named task

Named task: Independent task: Choose from new results, questions 1 and 4

Fictional response — sound for the named task: “D is better supported for limiting warming here. D/C end at 16/18°C in Trial 1, 15/17°C in Trial 2 and 16/18°C in Trial 3, with matching 11°C starts. D warms 5, 4 and 5°C, less than C in every matched row. D did not cool its water: each final value is above the start. This supports these stated conditions, not every room or sleeve version.”

Visible evidence: All-row choice support and accurate rejection of cooling for the named questions.

Not established: The full scientific explanation or additional next-evidence response requested elsewhere on the independent sheet.

Clarify: Ask for those separate explanation/limit responses rather than treating this excerpt as the whole assessment.

Next teaching/evidence: After completing the other named independent prompts, reserve Later assessment for a later occasion.

This response is invented for teacher interpretation. Accept defensible alternatives. Record access, prior exposure and the actual response; do not assign an ability label or claim mastery from this example.

Later assessment

Fictional teaching response — partially developed

Named task: Independent task: Choose from new results, questions 1 and 4

Fictional response — partially developed: “D is best: 16°C is lower than 18°C in Trial 1.”

Visible evidence: One accurate matched comparison.

Not established: All-row consistency, relation to the common start or scope.

Clarify: Ask what happens in Trials 2 and 3 and whether a lower endpoint proves cooling.

Next teaching/evidence: Use Use all results and limit the claim, questions 1–3, where J/K do not give an all-trial winner. Reserve the separate New short check, question 4, until after practice.

This response is invented for teacher interpretation. Accept defensible alternatives. Record access, prior exposure and the actual response; do not assign an ability label or claim mastery from this example.

Use all results and limit the claim

Fresh recheck after reteaching

Reserve: Later assessment

Fictional teaching response — plausible error

Named task: Independent task: Choose from new results, questions 1 and 4

Fictional response — plausible error: “D cooled the water because it is colder than the no-sleeve cup.”

Visible evidence: An accurate relative endpoint ordering.

Not established: Cooling over the interval; D’s final temperatures remain above 11°C.

Clarify: Ask for each sample’s own start→finish→change before comparing endpoints across designs.

Next teaching/evidence: Use Compare the measurements in the practice-only current file. Then give its separate reserved cooling-direction fresh check, question 3. Keep the earlier combined sheet in the archive.

This response is invented for teacher interpretation. Accept defensible alternatives. Record access, prior exposure and the actual response; do not assign an ability label or claim mastery from this example.

Compare the measurements

Reserve until after this practice: Compare the measurements — fresh check

Reserve: Later assessment