

Optional Science: data, investigations and models

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Scope and prerequisites

ACT framework, February 2026 revision. Original classroom cases are not an official form; preserve the scored/field-test boundaries of each source form.

- Interpret data and graphical relationships
- Evaluate experimental methods and variables
- Compare scientific arguments and predictions against evidence

Prerequisites: Independent/dependent variables; controls; design constraints.

Explain and choose the method

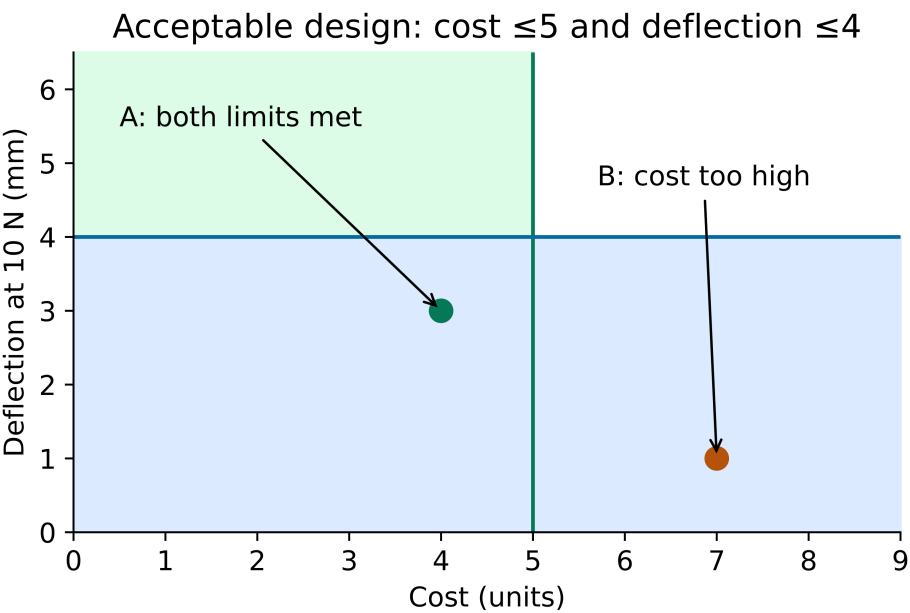
Identify the independent and dependent variables, axes and units. Interpolate only within the supplied data range.

Find which factor changes between trials and which factors remain controlled. Replication tests repeatability.

For conflicting viewpoints, write one prediction for each model and look for a discriminating observation.

Use the supplied scientific context. Many questions require evidence reasoning rather than recall of a specialist fact.

A controlled comparison changes the proposed cause while holding alternative causes fixed. An engineering design must satisfy every stated constraint. Repetition estimates variation; it does not undo a change of both material and thickness.



Original worked example from existing native teaching; transfer tasks use their own data.

Existing worked example: Trial 1 uses 10 mL acid and takes 40 s; Trial 2 uses 20 mL and takes 25 s at the same temperature. More acid is associated with a shorter time here. A third trial at a hotter temperature cannot isolate the acid-volume effect.

Complete original context

Original hypothetical research summary – A cooling sleeve

A laboratory team tests sleeves intended to reduce a small sensor’s temperature during operation. All sensors start at 22°C. Temperature is measured after ten minutes of use with the same power setting, room conditions and measuring instrument. Sleeve A costs 4 units, B costs 7 units, and an unsleeved sensor is the control. The design brief requires a cost no greater than 5 units and a final temperature no greater than 35°C. Lower temperature alone is not the only design criterion.

Experiment 1 uses identical sensors and records three independent trials per sleeve. Final temperatures in °C are: control 41,42,43; A 33,34,35; B 30,31,32. The team resets the starting temperature and checks the sensor charge before each trial. They report the means and the full observed ranges. The ranges describe these trials, not every future result. The team has not yet measured sleeve durability.

Experiment 2 investigates thickness for material A. Each sleeve has the same length and fit; thicknesses are 1,2,3 mm. Mean final temperatures are 38,34,32°C respectively. All other stated conditions match Experiment 1. Changing thickness also changes material quantity, so a future design review must measure costs instead of assuming

they stay at 4 units. A student proposes testing a 3-mm sleeve in material B against a 1-mm sleeve in material A to identify thickness's effect. This comparison would change two factors at once.

Two original models explain the observed temperature pattern. Model P says final temperature depends only on thickness, regardless of material. Model Q says both thickness and material matter; at equal thickness it predicts that material B produces a lower final temperature than A under the same conditions. Both models predict lower final temperatures as thickness rises over the tested 1–3 mm interval. A decreasing trend alone therefore cannot separate them.

Experiment 3 tests new A and B sleeves, each 2 mm thick, in matched conditions. Mean final temperatures are A 34°C and B 31°C. The measuring instrument's stated resolution is 0.1°C, and the team checks its calibration with a reference. Repeated trials would still be needed to characterise variability and rule out other differences in manufacture. The result conflicts with P's material-independence prediction and is consistent with Q's direction; it is not proof that Q is the only possible explanation.

A separate time series for one sensor with sleeve A records temperatures 22,28,32,34°C at 0,2,4,6 minutes. These observations show warming with successively smaller two-minute increases. No measurements beyond six minutes are supplied in this series. A proposal to continue the first interval's slope to twelve minutes is a model assumption that later measurements may contradict, not a reading from the table.

Independent practice and checked reasoning

This overview is completed through the detailed skill sequence: 26, 27, 28. Work those references and sheets in order; this orientation does not replace them.

■ Transfer 1

Find mean and observed range for control, A and B in Experiment 1. Which sleeve satisfies both design constraints in these trials?

Reasoning: Control mean 42°C, range 41–43°C; A mean 34°C, range 33–35°C; B mean 31°C, range 30–32°C. A costs $4 \leq 5$ and reaches at most 35°C, so it meets both in these trials. B's lower temperatures do not overcome cost $7 > 5$. This does not guarantee future durability or temperatures.

■ Transfer 2

Identify the changed and measured variables in Experiment 2. Why does the student's A-versus-B proposal fail to isolate thickness?

Reasoning: Thickness is changed and final temperature measured. Material, length, fit, starting temperature and operating conditions are controlled in Experiment 2. The proposal changes material and thickness together, so either could explain a difference; repeats would not remove that confounding.

■ Transfer 3

Propose a follow-up for the 3-mm A design that addresses a previously unmeasured requirement and preserves a fair temperature comparison.

Reasoning: Measure its actual cost and durability, while repeating matched final-temperature tests with the same material, length, fit, power, starting temperature and duration. The heavier sleeve's cost cannot be assumed unchanged. State acceptance limits before choosing, rather than deciding from cooling alone.

Limits and next use

Science is optional for individual ACT registrations, but a school contract or target institution may require it. It is not part of the enhanced EMR Composite.

All tasks here are public original practice with authored guidance. They are not official questions or fresh diagnostics. Existing protected tests and mocks remain separate.