

When does a comparison earn a conclusion?

Goal: critique a proposed comparison, separate variation from systematic error, and design a bounded transfer test.

Name: _____ Date: _____

Planning scenario, not measured results: You want to find whether changing a marble's release mark affects whether it stays in the cup. No marble experiment is needed for this worksheet.

HS01 | First decision: in a hypothetical plan, all A trials use one cup position and all B trials use a different cup position. Someone wants to attribute any outcome difference to the release mark alone. Identify the competing explanation and a design change that would make the claim more defensible. Explain rather than naming a term.

SETTING A: release mark A

SETTING B: release mark B

Keep comparable in both:

marble / track / cup / let-go method

Observe: stayed or missed

Repeat BOTH settings; note changes.

Plan, not results: Setting A uses release mark A and Setting B uses release mark B. In both, keep the marble, track, cup and let-go method comparable. Record stayed or missed and notes about changed conditions for repeated trials of each setting.

Read the supporting explanation on page 2 after recording your first reasoning.

What was held steady - and what was assumed?

A factor is something you deliberately change. A response is the outcome you observe. In this simple comparison, change the release mark and keep the marble, track, cup and let-go method as steady as possible. Repeat both settings and keep all outcomes, including misses. Note any changed conditions. Variation means differences among repeated observations. A systematic error can persist in repeated measurements, such as a misplaced zero mark. Repetition does not by itself remove that error or prove a rule for every setup. Experiments can also be designed to study several factors together.

HS02 | Design a recording and decision procedure before conducting any trials. Define the response, comparable conditions, repetitions of both settings, and notes to retain when conditions change. Explain how you would report a shifted-track trial without either hiding it or presenting it as an unchanged comparison.

HS03 | Compare two hypothetical problems: small differences among repeated measurements under apparently unchanged conditions; a measuring tool whose zero mark is misplaced every time. What can repeated readings reveal? What does agreement alone leave unresolved? Name an additional check you would propose and explain its purpose; do not claim an unperformed check succeeded.

Carry the reasoning into a different setting

HS04 | Transfer design: compare two arrangements of study notes for finding a named topic. Specify a changed factor, an observable response, comparable conditions and repeats of both arrangements. Consider how familiarity with a topic could confuse the comparison. Describe a way to make that influence visible or keep the task comparable. State what your design still cannot establish.

HS05 | A hypothetical report says: "We repeated our measurements and they agreed, so the method is accurate in every situation." Separate its two unsupported conclusions. Rewrite the conclusion so it distinguishes what was observed from what remains untested. No numerical data or universal success claim is supplied.

A story connection, with its evidence boundary

HS06 | In One More Take, Quinn repeats releases and retests after relocating the cup. Explain why the new arrangement needs its own observations even if a previous setting worked. What record would let someone inspect the comparison? Distinguish a story illustration from measured evidence.

Source notes (all activities here are paper planning)

NIST experimental design - planned factors, responses and uncontrolled influences
<https://www.itl.nist.gov/div898/handbook/pri/section1/pri11.htm>

NIST variability - differences among repeated measurements
<https://www.itl.nist.gov/div898/handbook/mpc/section1/mpc114.htm>

NIST measurement terminology - agreement, accuracy and systematic error (D.1.1.1-6)
<https://www.nist.gov/pml/nist-technical-note-1297/nist-tn-1297-appendix-d1-terminology>