

2027-04-15 · 80 minutes

CER paragraph

Your goal: Write a claim-evidence-reasoning paragraph and distinguish correlation from causation in your data.

One product: CER paragraph with a specific claim supported by cited graph data, reasoning linking evidence to claim, a correlation/causation classification with justification, and one alternative explanation.

Question: Your graph shows two things rising together in your environmental data. What is the exact claim your numbers support, and can you honestly say one caused the other?

Start the work

Show every record and the scale rule; an endpoint supports a conditional interval, not an exact concentration.

1. Preserve your actual prior point or interval and teacher reference if supplied. Otherwise label H1 original practice; compare the retained interval with the fictional reference and calculate the newly chosen point comparison.
2. State a claim your graph supports.
3. Cite specific evidence from the data table or graph.
4. Explain the reasoning linking evidence to claim.
5. Decide whether your data shows correlation or causation and justify it.
6. Note one possible alternative explanation. Compare the point error with the additive interval width in matching units; keep original arithmetic separate from any missing actual comparison.

Save the same dated original record if the route is unavailable. Label actual graph, prior estimate, teacher reference, official work and submission pending as needed.

Words you will use

claim

A specific statement supported by evidence.

observation

Something noticed or recorded.

evidence

Information used to support or challenge a claim.

reasoning

An explanation connecting evidence to a claim.

CER

Claim, evidence and reasoning in a connected scientific argument.

correlation

A pattern in which two variables vary together; it does not by itself establish cause.

association

A relationship between variables in supplied or observed records.

causation

A relationship in which changing one factor produces a change in another under the relevant conditions.

empirical

Based on actual observation or experiment rather than a constructed example.

simulation

A constructed representation using stated rules or invented records.

hypothesis

A proposed explanation or prediction that evidence could test.

alternative explanation

Another possible account of a pattern that requires its own evidence.

confounding

Distortion of a relationship by a third factor associated with the compared variables.

bias

A systematic distortion introduced by how information or participants are selected, recorded or interpreted.

observational study

A study that records existing conditions without assigning the exposure or intervention.

controlled experiment

A study that deliberately changes an input while managing other conditions to test a response.

control

A condition or comparison used to isolate or check a factor in a study.

independent variable

The input deliberately varied in an experiment; here the modeled starting concentration.

dependent variable

The recorded response; here endpoint well number.

concentration

Amount of a substance per stated volume of mixture.

nominal concentration

An assigned or calculated concentration, not necessarily an actual measured value.

mg/L

Milligrams per liter, a mass-per-volume concentration unit.

milligram

One thousandth of a gram.

liter

A unit of volume.

dilution

Lowering concentration by adding diluent under the stated conditions.

twofold series

An ideal sequence in which each well has half the concentration of the previous well.

indicator

A substance giving a visible response under specified conditions.

threshold

The boundary used for a decision; here the declared model rule, not a validated detection limit.

positive

Meeting the declared response rule.

negative

Not meeting that rule; it is not proof of universal absence.

blank

A comparison without added target substance under the stated conditions.

endpoint

The last well meeting the positive rule in a valid ordered series.

calibration

Using a model to translate a measured response to a quantity on another scale.

reference

A stated comparison value with a known source; today the 12 mg/L value is fictional.

point estimate

One numerical value used to estimate an unknown quantity.

interval

A set of values between stated bounds.

coverage

Whether a reference belongs to the stated interval; not the same as point error.

half-open interval

An interval that includes one boundary and excludes the other.

signed difference

Point value minus reference, retaining positive or negative direction.

absolute error

The magnitude of point value minus reference, without its sign.

additive width

Upper bound minus lower bound, in the original units.

multiplicative factor

Upper bound divided by lower bound when both are positive; a unitless ratio.

log2

The exponent of two giving a positive number; it counts doublings.

stepwise

Changing in discrete steps rather than continuously.

censored endpoint

A boundary response giving only a one-sided concentration limit.

outlier

A record that differs substantially from the surrounding pattern.

replicate

A repeated record under specified conditions, retaining its own identity.

precision

Agreement among repeated measurements under stated conditions.

repeatability

Agreement of repeated measurements under the same specified conditions.

accuracy

Closeness to an appropriate reference or true value.

uncertainty

Limits on what is known about a result.

confidence interval

A statistical interval constructed by a specified procedure with a stated coverage interpretation.

range

The observed minimum through maximum, or their difference when explicitly stated.

error bar

A plotted interval whose meaning and calculation must be identified.

exposure

Contact with an agent through a stated route over time.

dose

An amount entering or absorbed by a body, sometimes normalized to body mass and time.

asthma

A long-term airway condition in which airways can become inflamed and narrowed; Q1 does not establish diagnoses.

utilization

Use of a service, such as counts of nurse encounters.

denominator

The quantity by which a count is divided to form a proportion or rate.

paired values

Two values belonging to the same record, such as one fictional day.

provenance

The source and history of a value or record.

peer review

Feedback from another person; a solo check is labeled separately.

H1: original continuation and the missing actual reveal

This is a paper continuation of the original April 13 model. No actual sample, student result, class chart or teacher reveal is supplied.

First label your prior record as an actual point estimate, an actual interval, the supplied original interval, or unavailable. Preserve its exact wording and units; do not invent an earlier answer.

Use your April 13 interval for U; your teacher will confirm the class interval at the start of class. Today adds a fictional reference of 12 mg/L for an arithmetic exercise only.

For a separate point comparison, choose 8 mg/L now as a supplied value. This new illustrative comparison value is not your historical estimate or an exact April 13 result.

If you have only an interval, test whether the reference is inside it. Do not assign zero point error merely because the reference is covered.

Actual analysis needs your original table, graph, point or interval, method and repeated records, blank and unknown calls, and the teacher reference with its source.

Keep missing actual inputs pending. Do not load liquid, use iodine, start a timer or collect human information for this paper lesson.

D1: complete original records retained from April 13

All rows below are invented instructional records. Nominal starting concentration is stated in milligrams per liter before indicator addition; final indicator volume is not supplied.

The model threshold T is 1 mg/L. A well at or above T is positive, P, meaning darker than the yellow-brown blank. A lower value is negative, N, matching the blank.

Six wells contain C, C/2, C/4, C/8, C/16 and C/32. These are five halvings, not six. Every record assumes the same original comparison rule.

Known A starts at 2 mg/L. Wells 1-6: 2, 1, 0.5, 0.25, 0.125, 0.0625. Calls P P N N N N; endpoint 2.

Known B starts at 4 mg/L. Wells 1-6: 4, 2, 1, 0.5, 0.25, 0.125. Calls P P P N N N; endpoint 3.

Known C starts at 8 mg/L. Wells 1-6: 8, 4, 2, 1, 0.5, 0.25. Calls P P P P N N; endpoint 4.

Known D starts at 16 mg/L. Wells 1-6: 16, 8, 4, 2, 1, 0.5. Calls P P P P P N; endpoint 5.

C2 repeats the nominal C concentration row, but its supplied calls are P P P N N N; endpoint 3. Keep this deliberate disagreement; its cause is not known.

C3 repeats the same nominal row with P P P P N N; endpoint 4. The three 8 mg/L records are C, C2 and C3, not one averaged replacement.

BL has zero added starch and is yellow-brown, recorded N. It defines the comparison appearance; it does not prove every transfer or reagent worked.

U has no revealed concentration. Its symbolic wells are U, U/2, U/4, U/8, U/16 and U/32. Calls P P P P N N; endpoint 4.

The complete pooled start/endpoint pairs are A (2, 2), B (4, 3), C (8, 4), D (16, 5), C2 (8, 3), C3 (8, 4). Starts have units mg/L.

E2: use the actual supplied graph with its scale rule

Use your April 13 calibration graph. Its horizontal coordinate x equals $\log_2(C/T)$: the number of doublings from threshold T. Its vertical coordinate e is endpoint well number.

Label each tick with both its x value and its concentration, as on your April 13 graph. Equal horizontal gaps mean equal ratios, not equal concentration differences.

A, B, C and D lie on the ideal reference line from your April 13 graph within the known range. The reference is not a fit claiming that all records agree.

C and C3 share one position, labeled two records. C2 remains flagged. U has endpoint 4 with an included left and excluded right interval bound.

NIST describes calibration as converting between measurement scales using a model. Its guidance calls for uncertainty assessment; a line alone is not proof of accuracy.

The actual endpoint response is stepwise. The ideal reference supplies a reading guide, not an exact continuous response or a validated real calibration.

At 8 mg/L, report the observed range of the three endpoints. This range is not a confidence interval.

Other known levels have only one record. Do not claim their precision or invent error bars. Keep the flagged record and distinguish a possible error from a demonstrated cause.

E3: interval coverage and a new point comparison

The last positive and next negative wells bound U. Apply threshold T to U's last positive well and its first negative well.

Use your April 13 interval for U. A square bracket includes its bound; a round bracket excludes its bound.

Check whether the new fictional reference 12 mg/L lies inside your interval. Coverage under the model is not zero point error or validation of an actual sample.

For the newly chosen point $p = 8$ mg/L and fictional reference $r = 12$ mg/L, signed difference is p minus r . Keep its sign and units.

Absolute error is the magnitude of that difference. Additive interval width is the upper bound minus the lower bound. Compare the illustrative error with that width.

The multiplicative interval factor is the upper bound divided by the lower bound. It has no units. It is not a plus-or-minus range in mg/L or a confidence interval.

Equal factors do not mean equal widths: $[50, 250)$ and $[90, 450)$ both have factor 5, yet they span 200 and 360 mg/L. Compare quantities in matching units.

A reference exactly on an excluded bound would lie outside the interval. Endpoints 0 and 6 give only one-sided bounds, as in your April 13 boundary checks.

These censored cases lie outside the known calibration range. Do not extend the ideal line to make them exact values.

C2 disagreement warns that real pooling could add uncertainty. A fictional reference inside the interval would still not prove repeatability, accuracy of an actual method or a causal mechanism.

Starch concentration is not pollutant exposure, intake or absorbed dose. No breathing volume, intake, body mass or duration is supplied to calculate any dose.

S1: judge the design before the causal claim

NIST explains that a scatter plot can reveal association without proving cause. Its experimental-design guidance links planned changes in input factors to recorded responses.

CDC warns that an association can reflect chance, biased information or selection, confounding, or other error. Interpretation requires the design, timing and other evidence.

The D1 pairs were generated for a model. Describe their positive pattern as a model association under stated rules, not an observed environmental correlation or empirical causal proof.

A real controlled assay could vary concentration while keeping other conditions matched to test its effect on response. Actual controls, comparable methods and repeated results would still matter.

A classroom assay would not establish that a pollutant caused illness. Different claims require different designs and evidence; there is no rule that all environmental evidence is only correlational.

For D1, imperfect mixing, transfer differences or call differences could explain a real discrepant repeat. Here those are possible explanations, not established facts about C2.

For an optional next test, propose independent repeated known samples with a fixed reading rule and a recorded mixing protocol. Explain which uncertainty that comparison would address.

This is a design proposal, not permission to run a lab. One added measurement can reduce a named gap without resolving every source of error or proving a cause.

R1: build the full paragraph

Warmup 1: explain how a claim differs from an observation. Warmup 2: give one reason two variables rising together need not mean one caused the other.

Prerequisite frame: As ____ increased, ____ _____. Use A-D to describe the ideal pattern, then explicitly account for C2. Do not force an exception into a perfect trend.

A claim states a supported relationship with its scope. Evidence cites the actual supplied values and source label. Reasoning explains how those values support the claim.

In this exercise, cite original D1 values as original values. Numerical detail does not turn an invented record into an actual measurement.

Claim starter: in one sentence, name the direction of the anchor pattern and the repeated record that disagrees. Choose specific D1 pairs as evidence.

Reasoning should connect the five-halving rule to endpoint changes, explain the graph scale, and preserve C2. State that model behavior does not establish actual environmental causation.

Add one possible alternative explanation for disagreement and the evidence needed to test it. Include your E3 coverage/error comparison without calling the new point a prior estimate.

Recovery: write the claim and one D1 number pair first, such as A at 2 mg/L with endpoint 2. Then add reasoning, classification, alternative and comparison to complete the product.

Restart by finding your claim field, checking its cited values, then filling the reasoning field.

Q1: complete fictional traffic and visit self-check

Original practice only: the following five pairs describe an invented campus, not a real school or any individual. The category asthma-related nurse visits is a fictional log label.

Traffic is vehicles passing a fixed fictional gate during the same 30-minute morning window. Visits are total logged encounters over each school day, not unique people or new asthma cases.

Day A: 100 vehicles, 2 visits. Day B: 120 vehicles, 3 visits. Day C: 140 vehicles, 3 visits. Day D: 160 vehicles, 4 visits. Friday: 180 vehicles, 5 visits.

No person, diagnosis, exposure measurement, attendance denominator or actual record is supplied. Counts across these two time windows do not establish an individual exposure-response relationship.

Your graph shows traffic volume and asthma-related nurse visits both rising across the week. A classmate writes: This proves cars cause asthma. Rewrite it as a defensible CER claim.

Use at least two exact paired values and units. Explain why the pattern is an association, give one possible alternative, and state what remains unknown.

Check your rewrite: it names the direction of the association and cites two exact day pairs with units.

An association in these pairs cannot diagnose asthma or prove traffic caused it. Check whether every day follows the overall pattern.

For your alternative, name one unmeasured factor that could change both counts. Call it a possibility, not a discovered cause, and name the records needed to assess it.

If your rewrite says proves or diagnoses, replace that claim and explain the design limit. Do not replace it with a claim that your alternative certainly caused the pattern.

T1: peer review or a complete solo counterpart

With an available partner, exchange paragraphs and record the actual critique. Ask whether the claim, cited values, reasoning and limits can be understood without looking at the graph.

Without a partner, use this supplied critique: Your paragraph lists A-D but hides C2. It also calls 8 mg/L your earlier estimate without a record and treats coverage as zero error.

Write a labeled solo response. Check whether each criticism fits your draft. Quote the sentence you keep or change, then write the corrected sentence and why.

Confirm the final paragraph includes a specific claim, numerical evidence, reasoning, design-based classification, an alternative explanation and the separate unknown comparison.

Keep actual peer exchange pending when absent. A complete original solo revision can finish the written practice without pretending someone reviewed it.

For deep-unit review: a line graph can emphasize change over ordered time; an outlier differs from a pattern; association does not prove cause. Defined error bars can express variation or uncertainty.

P1: authentic assignment and next-day status

Today's directions name Activity 4.1.3 Testing the Waters, the CER folder, and the current Problem 4 portfolio. Open the linked BI assignment and check its posted requirements and deadline.

Activity 4.1.3 uses eleven tests on two waters, its resource sheet, actual results and health notes, research, and peer/remediation comparison. This starch endpoint practice does not replace it.

Keep the actual graph, original estimate or interval, teacher reference, stock basis, protocol, blank and repeated records pending when missing. This original continuation does not complete that actual comparison.

Complete the confirmed official prompts and required evidence separately. The source model does not replace an official resource sheet, real results or genuine completion evidence.

This week, April 12-16, also includes environmental exposure-map and public-data analysis work. Actual public data and unfinished exposure-map obligations remain separate.

April 14 is catch-up. No homework is due before this class. April 16 asks for the combined claim graph and named Project 4.1.4 Dose Response work; those are not completed here.

Keep this paragraph with its table, graph and source labels for the next submission step. Actual April 13 completion is not assumed, and a saved draft is not a submitted assignment.

M1: a different original CER, printer workload

Three invented one-hour printer records are supplied: 10 queued jobs and 8 completed; 20 queued and 14 completed; 30 queued and 18 completed. No actual printer was observed.

Full model paragraph: In these original records, larger queues accompany more completed jobs. Completions rise from 8 with 10 queued jobs to 18 with 30 queued jobs.

The pairs support a positive association, since both values are larger in the last record. They do not prove adding jobs causes greater printer capacity.

One possible alternative is that an extra operator was available for larger queues. Staffing was not recorded, so this remains a hypothesis rather than a finding.

Revision check: the paragraph names its original status, two pairs, the relationship, the reasoning and an alternative. A proposed next record would log staffing for matched one-hour comparisons.

That extra record could address staffing differences without proving every causal claim. Printer jobs supply no evidence about starch, traffic or illness.

Try the decision

Use your April 13 interval for U. Today introduces fictional reference 12 mg/L and a newly chosen point of 8 mg/L. Which report is supported?

- Report coverage, the new point's absolute error and the interval width as separate quantities, without establishing a real result.
- Covering the reference means the student previously predicted exactly 12 mg/L with zero error.
- Calculating point error proves traffic caused asthma and the actual calibration has no uncertainty.

Explain your choice using the reading. Discuss it or say it to yourself. This practice does not add another submission.

Your 80-minute flow

0–10 minutes	Preserve prior point or interval status; use supplied original inputs for the separate coverage and new point comparison.
10–20 minutes	Draft the claim and cite the graph values, including C2.
20–40 minutes	Write reasoning connecting the values, scale rule and claim.
40–55 minutes	Classify the design and complete the fictional Q1 association check.
55–70 minutes	Add a possible alternative; propose the optional next test when ready.
70–80 minutes	Review with a peer or T1 solo critique, revise the paragraph and record authentic status.

Your response record

Use these labels on paper or in your document. The space below also works when this page is printed.

Preserve the prior result and compare honestly

Answer both R1 warmups. Label the prior result and reference source; complete E3 interval coverage, signed difference, absolute error, additive width and factor comparison.

Use 12 mg/L only as the new fictional reference and 8 mg/L only as the newly chosen illustrative point. Keep actual prior and reveal fields pending when unavailable.

Use this space or the same labeled section in your existing document. Add paper when your table, graph or drawing needs more room.

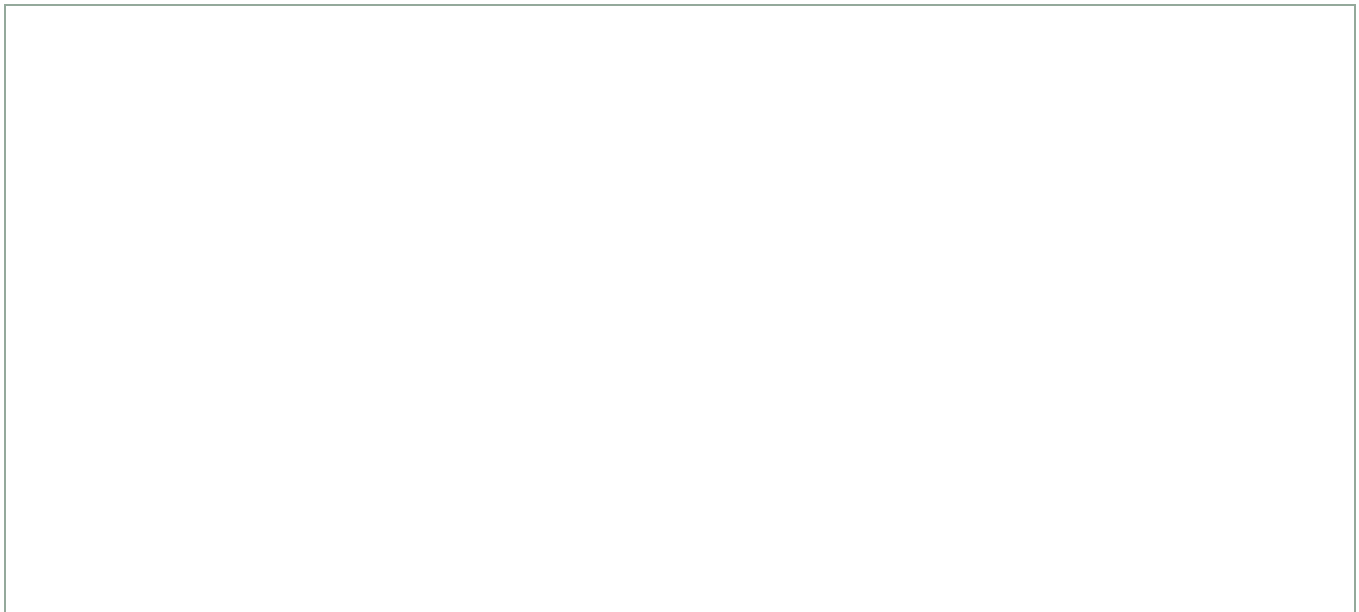


State the claim and cite the complete graph

Use the R1 frame, D1 and your April 13 calibration graph to draft a specific claim. Cite at least two anchor pairs and the C2 exception; retain C and C3 as separate records.

All inputs are supplied. Your claim can describe a model association without inventing actual measurements or a causal result.

Use this space or the same labeled section in your existing document. Add paper when your table, graph or drawing needs more room.

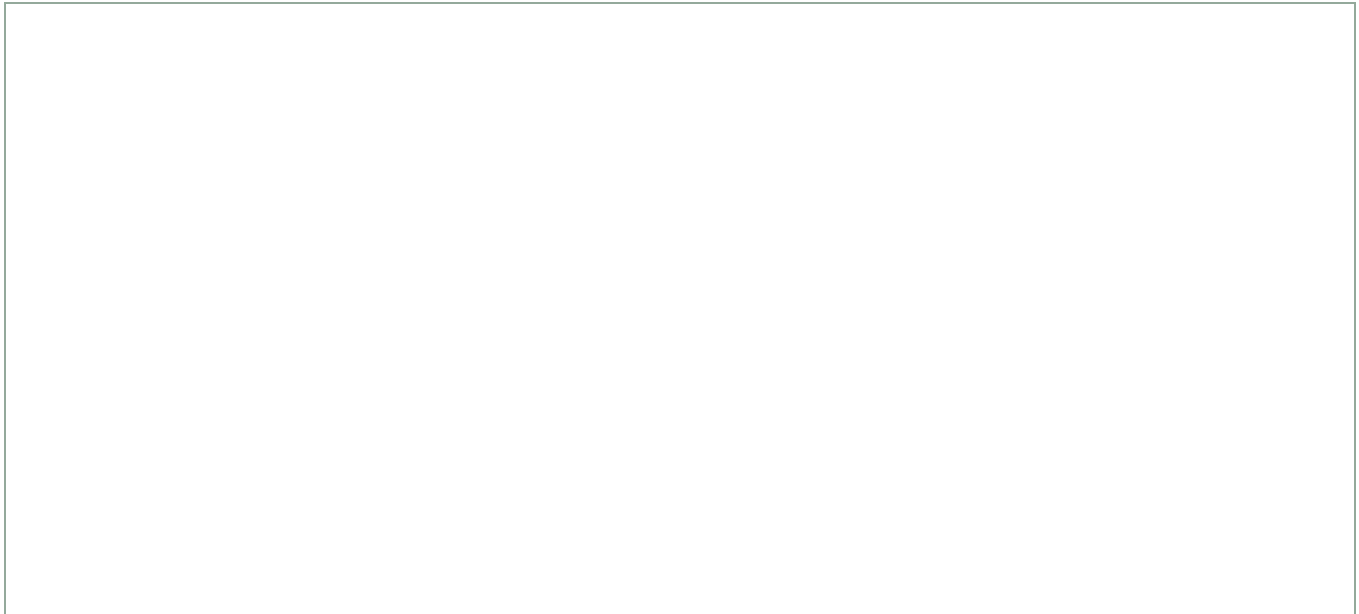


Explain the evidence and classify the design

Write the reasoning that connects the concentration rule, graph values and claim. Classify the original model separately from actual controlled or observational evidence, using S1.

A simulated pattern is not empirical proof. Include the conditional interval and one possible explanation for C2; do not erase it.

Use this space or the same labeled section in your existing document. Add paper when your table, graph or drawing needs more room.

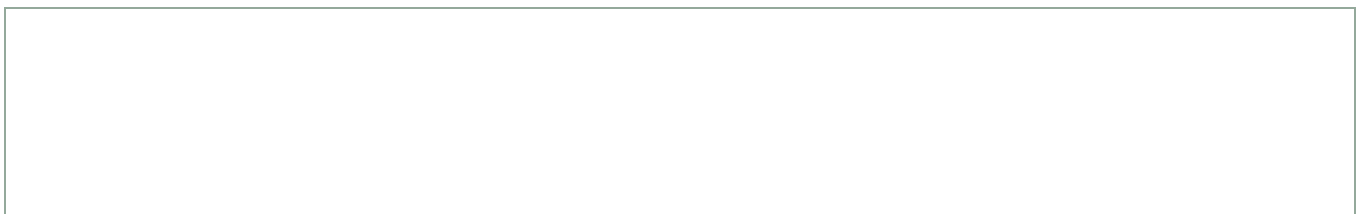


Rewrite the traffic claim and propose a next test

Complete Q1 with two paired numerical examples, a justified association claim and one possible alternative. For extension, propose one measurement or control and explain the specific gap it addresses.

The paired counts are fictional utilization data, not diagnoses. The extension is a proposal; no human records or measurements are authorized.

Use this space or the same labeled section in your existing document. Add paper when your table, graph or drawing needs more room.



Review and revise the full paragraph

Write the complete CER product and unknown comparison. Use an actual peer response or the supplied T1 solo critique; retain a before/after sentence and the reason for revision.

The paragraph must make sense without the graph. Recovery starts with claim and a number but must return to reasoning, classification, alternative and the comparison.

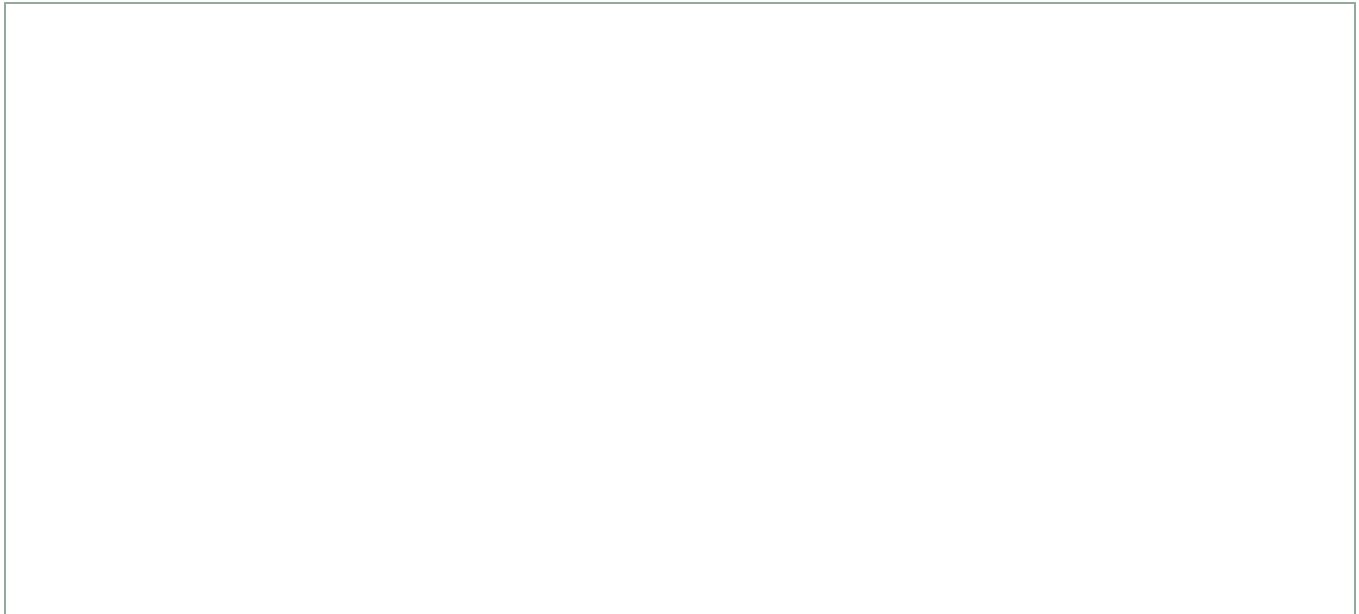
Use this space or the same labeled section in your existing document. Add paper when your table, graph or drawing needs more room.

Keep the evidence together and record status

Check the full product, source labels and P1 obligations. Keep your paragraph beside its table and graph; submit through the confirmed route or save the same record with pending status.

No actual prior graph, teacher reveal, official completion, peer exchange or submission is assumed.

Use this space or the same labeled section in your existing document. Add paper when your table, graph or drawing needs more room.

A large, empty rectangular box with a thin black border, intended for recording evidence or providing additional information. It occupies the lower half of the page.

Check your product

- The paragraph contains a specific claim, cited numerical evidence and reasoning.
- The relationship is classified with a design-based justification and one alternative explanation.
- The unknown comparison distinguishes actual inputs from original practice, interval coverage from point error, and width from factor.
- C2 and every repeated record remain visible; no actual result, peer exchange or completion is invented.

Keep the limit: Original paper models support conditional arithmetic and evidence reasoning. They cannot establish any actual sample concentration, causal health effect, diagnosis, clinical action or official completion.

Turn in your work

Submit the complete CER with its supporting table and graph through the teacher-confirmed April 15 Claim Evidence Reasoning route in your enrolled BI section and current Problem 4 portfolio.

Save the same dated original record if the route is unavailable. Label actual graph, prior estimate, teacher reference, official work and submission pending as needed.

[Open this assignment in Schoology.](#)

Carry forward

Keep interval coverage separate from point error, and support each causal claim with the design and evidence it needs.

Carry the table, labeled graph, complete CER and actual-status notes into the April 16 claim-graph submission. Which graph feature supports your claim, and what does it leave unresolved?

Sources and resources

[Open today's page](#)

NIST-CAL · Calibration

NIST/SEMATECH e-Handbook 4.1.3.3

<https://www.itl.nist.gov/div898/handbook/pmd/section1/pmd133.htm>

NIST-SCATTER · Scatter Plot

NIST/SEMATECH e-Handbook 1.3.3.26

<https://www.itl.nist.gov/div898/handbook/eda/section3/scatterp.htm>

NIST-DESIGN · What is experimental design?

National Institute of Standards and Technology

<https://www.itl.nist.gov/div898/handbook/pri/section1/pri11.htm>

CDC-INTERPRET · Analyzing and Interpreting Data

CDC Field Epidemiology Manual, Chapter 8

<https://www.cdc.gov/field-epi-manual/php/chapters/analyze-interpret-data.html>

OPENSTAX-DILUTION · Chemistry 2e: 3.3 Molarity, dilution subsection

OpenStax, Rice University

<https://openstax.org/books/chemistry-2e/pages/3-3-molarity>

NHLBI-ASTHMA · Asthma: What Is Asthma?

National Heart, Lung, and Blood Institute

<https://www.nhlbi.nih.gov/health/asthma>