

Wk12 Lab notebook: Variables and controls

Your goal: Define independent, dependent, and controlled variables using teacher notes and the PLTW online task.

One product: Labeled sample experiment with independent, dependent, and controlled variables identified, plus a written confounding-variable example.

Question: How can the design separate the factor being tested from alternative explanations?

Start the work

1. Take notes on variable types and experimental controls.
2. Define sample size and explain why it matters.
3. Complete the PLTW online variables-identification activity.
4. Label variables in a sample experiment description.
5. Write one example of a confounding variable.

If access is unavailable, save the same notebook and tell the teacher. You can use the supplied practice alone. Request the official task, teacher packet and later research-plan inputs before using them.

Words you will use

variable

A feature that can change or have different values.

independent variable

The factor deliberately changed or assigned in the stated experiment.

dependent variable

The response measured to address the question.

controlled variable

A condition kept consistent across the comparison.

control group

The stated comparison group, such as a baseline condition.

factor

An input or condition studied in an experiment.

treatment

The condition assigned to an experimental unit; this word does not imply medical care.

experimental unit

The smallest unit assigned a treatment independently in the stated design.

independent replication

Another treatment-assignment unit that supplies a separate replication under the design.

subsample

A smaller part observed within an experimental unit; it is not automatically another independent unit.

repeated measurement

Another reading of the same unit, which does not add a new treatment assignment.

sample size

A count of sampled units; state what kind of unit is being counted.

independence

The design assumption that one unit does not simply repeat or share another unit's treatment assignment or response influence.

precision

How little an estimate would vary across repeated samples under the stated design.

random variation

Chance differences across observations or samples.

systematic bias

A consistent distortion that more observations alone do not remove.

confounding variable

A factor linked to the comparison that creates another explanation for its result.

random assignment

Using chance to allocate treatments to units.

generalizability

How well a conclusion applies beyond the units and setting studied.

causal claim

A claim that changing one factor produced a change in a response.

lifespan

The length of an organism's life, measured with a stated starting and ending rule.

median

The middle ordered value, or the average of the two middle values for an even count.

strain

A specified genetic line within an organism used in research.

batch

A set prepared or obtained together that may share conditions.

assay

A defined test or measurement method used to study a biological response.

model organism

An organism studied to inform questions about a biological process.

C. elegans

Caenorhabditis elegans, a small roundworm used as a model organism.

literature

Published research and reports used as scientific sources.

hypothesis

A testable proposed explanation or prediction grounded in a question and evidence.

E1: notes on what changes and what is measured

An experiment starts with a question and a plan. The independent variable is the factor changed on purpose. The dependent variable is the measured response.

A controlled variable is a condition kept consistent. A control group is a comparison group. A comparison helps interpret a result but does not guarantee a cause.

NIST describes experiments that change one or more factors and measure one or more responses. One-factor practice is useful here, but valid designs can study several factors.

Write a three-column note: changed factor, measured response, conditions kept consistent. Then name the comparison group. Do not swap a changed factor with its measured response.

For the prerequisite sentence, label each part: I changed the sugar, measured lifespan, and kept temperature the same. Match each part to your three-column note: changed factor, measured response or condition kept consistent.

This sentence is a hypothetical design summary. It reports no sugar effect and gives no animal procedure. A conclusion also needs suitable measurements and a sound comparison.

E2: sample size, units and limits

The experimental unit is the smallest unit assigned a treatment independently in the stated design. Count those units, not just the measurements made on them.

If a whole plate receives one treatment, its worms share that assignment. Three hundred worms in that plate are not 300 independent treatment assignments.

Reading the same plate twice gives repeated measurements. It does not create another independently treated plate. Shared conditions can make measurements within one unit related.

NIST links precision to the number of independent replications, measurement error, variability and the sampling plan. More independent units can improve precision when the design supports that comparison.

More observations do not fix systematic bias or guarantee that results apply to other populations. First ask how units were selected, assigned and measured.

For the warmup comparing three worms with three hundred, ask how they were assigned. A larger count alone cannot tell you which design is stronger.

E3: confounding is a design problem

A confound is an alternative explanation tied to the factor being compared. For example, all treatment units might also be warm while all comparison units are cold.

NIST separates random variation from systematic errors that mix the effects of different factors. Adding more units with the same treatment-temperature link preserves that problem.

Random assignment uses chance to allocate treatments. It reduces systematic allocation patterns, but does not guarantee perfect balance of every unknown factor in one study.

A plan can also compare both treatments within each known condition, such as each room. Such a plan must account for the room in its analysis.

Extension: explain why increasing the number of units can improve precision yet leave confounding intact. Suggest a change to assignment or conditions, rather than promising numbers will erase bias.

B1: the projected bad design and both warmups

Original fictional bad design: a team proposes a sugar-versus-baseline worm comparison. Every sugar plate comes from batch A in a warm room.

Every baseline plate comes from batch B in a cold room. The team plans to record lifespan in days. No observations have been collected.

Name the intended independent and dependent variables. Identify two linked alternatives: batch and room temperature. Explain why a later difference could not isolate sugar in this design.

For a repair, propose both diet conditions within each batch and a common temperature. State that actual approval, measurements and a suitable analysis would still be needed.

Warmup 1: in a hypothetical test of whether caffeine speeds worm movement, what changes on purpose? Answer: the caffeine condition; no caffeine effect is supplied.

Warmup 2: why might testing three worms differ from testing three hundred? Use E2 to explain that assignment units and independence matter, not just the count.

The story of two labs with opposite results is only an illustration of a possible design concern. No actual laboratory result or temperature effect is established here.

S1: complete sample design for your notebook

Original fictional design for labeling only: compare diet condition A, described as added-sugar diet, with baseline diet B. The response is each plate's median lifespan in days.

Median means the middle value when values are ordered. For an even count, average the two middle values. No lifespan values or results are supplied or needed today.

The plan has 12 separate plates, each assigned independently of shared treatment batches. A chance-based allocation assigns six plates to A and six to B.

Each plate contains 25 worms, giving 300 worms in total.

The fictional plan holds starting worm age, strain, number per plate, base diet, observation schedule and lifespan-scoring rule consistent. It places all plates at the same planned temperature.

Both diet groups use the same lifespan measurement rule. Use E1 to decide which part of this plan is the comparison group and which conditions are kept consistent.

Label the independent variable, dependent variable with units, control group and at least three controlled variables. Name the assignment unit and report units per condition.

Then invent one clearly labeled change that would introduce confounding. State how it would become tied to diet, what alternate explanation it creates and how to repair it.

These counts and conditions are fictional task inputs, not recommended animal numbers or a runnable protocol. No diets, dosing, culture method or lifespan assay is authorized here.

R1: independent practice and recovery route

If the official activity is unavailable, use these three original scenarios during its time window. Ask for the official task; the practice does not replace it.

Practice A: a fictional planner varies light level between separately assigned plant pots, measures height in centimeters after seven days, and holds soil and water consistent.

Practice B: a planner assigns a paper bridge fold pattern to each separate bridge, measures sag in millimeters under the same stated load, and uses identical paper.

Practice C: a planner assigns a salt level to each separate yeast flask, measures foam height in millimeters after 20 minutes, and holds sugar amount and water temperature consistent.

For each, name the independent variable, dependent variable with units, two controlled variables and the assignment unit. All are design descriptions with no measured outcomes.

Check afterward: for each scenario, confirm that you named the factor changed on purpose, the measured response with its unit, two conditions kept consistent and the unit that receives each assignment.

If you reversed the first two labels, reread E1 and explain the correction.

Next label S1 without copying these answers. Write your own confounding example, then share with a partner or check it yourself using E3.

C1: music self-check and a careful answer

The original question tests louder music and worm speed using four worms in a warm room and four in a cold room. It does not say which room gets which volume.

Name the intended independent and dependent variables. Then check whether the prompt says which room gets which volume before deciding whether temperature could confound the comparison.

Explicit fictional condition for practice: all four high-volume worms are in the warm room; all four low-volume worms are in the cold room.

For that added condition, check whether volume and room temperature change together and whether temperature could offer an alternative explanation. No actual music or temperature effect has been measured.

Check your proposed comparison: does it stop volume and room temperature from changing together, and does the analysis still account for room?

Answer the original question with the missing-information caveat, then answer the added condition. Propose a comparison that separates volume from temperature without conducting it.

Do not claim eight independent volume assignments: if volume is assigned to a whole room, worms in that room share it. The unit is the room for that factor.

P1: official task, submission and remaining work

Today's class schedule starts Lesson 2.3 Challenge Accepted and asks you to define your experiment's variables. The daily record names a Problem 2.3.1 variables activity.

The exact variables screen and stopping point have not been verified. Ask for the assigned page; use the real task when available. Include only evidence from the task you actually do.

The official Toxic Relationships project is broader: background research, question, hypothesis, variables, controls, real data, errors, graph and scientific report.

Its Scientific Research section includes an Experimental Design resource, a mutant-sensitivity partner discussion, seeding videos and teacher-directed Module II-A culture work.

Those named official resources are not supplied here. No standalone variables screen was established. The actual guide, preparation, materials, rubric and teacher direction remain required.

The local notebook does not complete the experiment or justify marking the full project complete. Do not assume the earlier Monday-labeled task or April 6 debate is done.

This week's checklist still includes the endocrine organizer, model and 2.2.1 evidence.

Ask the teacher which of those to finish first. The separate research plan needs a real assigned literature excerpt and claim/method, question, controls, sample-size rationale and poster outline.

April 8 is a catch-up day. The next dated instructional context is April 9 research design and poster planning. No homework is due before this class.

No separate daily async task is specified. If the official task is unavailable, use B1, notes, R1, S1 and C1 alone and ask the teacher for the official task.

The week's teacher-posted packet and tracker evidence remain separate actual inputs. Do not invent a literature excerpt, partner response, completion screenshot or progress bar.

Submit Wk12 Lab notebook: Variables and controls through your enrolled section. Section 1292: <https://clevelandmetro.schoology.com/assignment/8544585662> . Section 6792: <https://clevelandmetro.schoology.com/assignment/8544585684> .

Confirm live access. Keep the labeled S1 description and written confound together, with notes and evidence from your assigned PLTW work. If access is absent, save the same work.

M1: worked design labels for fictional packaging

A fictional planner compares two carton flap shapes. Ten separate cartons are assigned by chance, five to each shape. The response is closure time in seconds.

The plan keeps cardboard thickness, carton size and timing rule consistent. Each carton receives its own shape assignment. There are 10 experimental units, five per shape.

Worked labels: flap shape is independent; closure time is dependent; thickness, size and timing rule are controlled. Shape A is the baseline comparison group.

If all shape A cartons were timed by one method and all shape B cartons by another, timing method would be confounded with shape.

Repair: use the same timing rule for both shapes and preserve the chance-based assignment. More cartons measured with the mismatched methods would not fix that flaw.

This is a paper design, not a measured usability result. Apply the labeling method to S1, whose diet, lifespan and plate units are different.

Try the decision

For S1, which notebook approach identifies the design without inventing a result?

- Label the factor S1 changes, the response it measures with units and the unit that receives each assignment, using S1's own description.
- Lifespan is the independent variable because it depends on diet; diet is the dependent variable because it is controlled by the planner.
- The 300 worms guarantee that any difference is caused by sugar and applies to all worms.

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	Read B1 and answer both warmups; identify batch and temperature alternatives.
10–28 minutes	Read E1-E3, define terms, build notes, label the prerequisite sentence and inspect M1.
28–45 minutes	Complete the assigned official activity when available; otherwise label and self-check all R1 scenarios and record the official hold.
45–60 minutes	Label all S1 variables, baseline, units and sample size in your notebook.
60–72 minutes	Write and repair a confounding scenario, partner-share or self-review, and answer C1. Extend with the sample-size correction if ready.
72–80 minutes	Check and submit the labeled sample and written confound; keep evidence from your assigned PLTW work and identify your next action.

Your response record

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

Diagnose the bad design

Use B1 to name the tested factor, response and two linked alternatives. Answer both warmups using E2 to qualify the sample-size comparison.

No experiment was run. A large worm count alone does not establish many independent units.

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

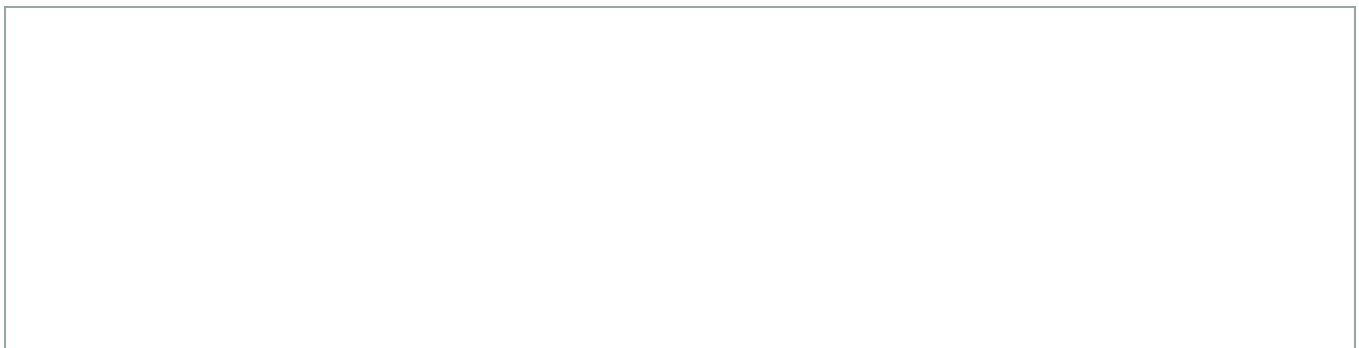


Build your variables notes

Read E1-E3 and M1. Make changed/measured/kept-consistent columns, label the sugar prerequisite sentence and define sample size with its unit. Explain precision versus confounding.

Separate a comparison group from a controlled condition. Use the worked carton example before labeling S1.

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

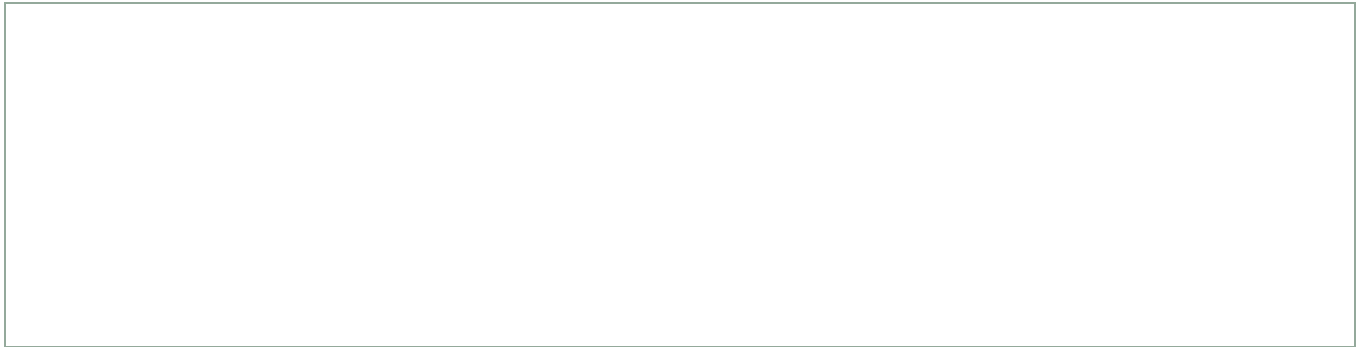


Complete the assigned online practice or record its hold

During 28-45 minutes use the actual assigned PLTW variables task if available. If the official task is unavailable, complete all three R1 scenarios and ask the teacher for that task.

Reread E1 if a label is unclear, then check each answer. Local practice never certifies the official screen or project.

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

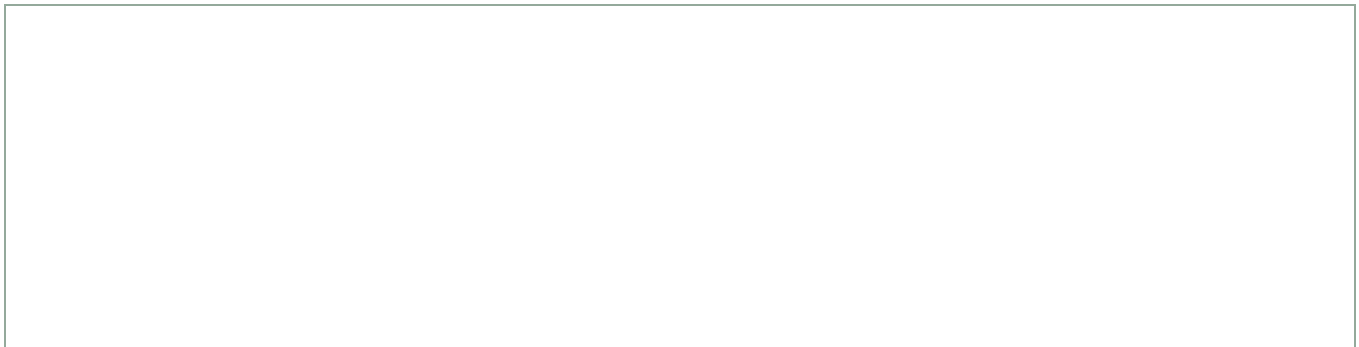


Label the complete sample experiment

Label S1 with independent variable, dependent variable and units, baseline control group, at least three controlled variables, assignment unit and units per condition.

Decide which unit receives each diet assignment, then count those units per condition. No lifespan calculation or animal procedure is required.

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



Create and repair a confounding example

Write one original change to S1 that ties another factor to diet. Explain its alternative explanation and a repair. Share with a partner or self-review using E3; complete C1.

For C1, distinguish the underspecified original prompt from the explicitly added volume-room pairing. Extension: explain why more units do not remove systematic confounding.

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

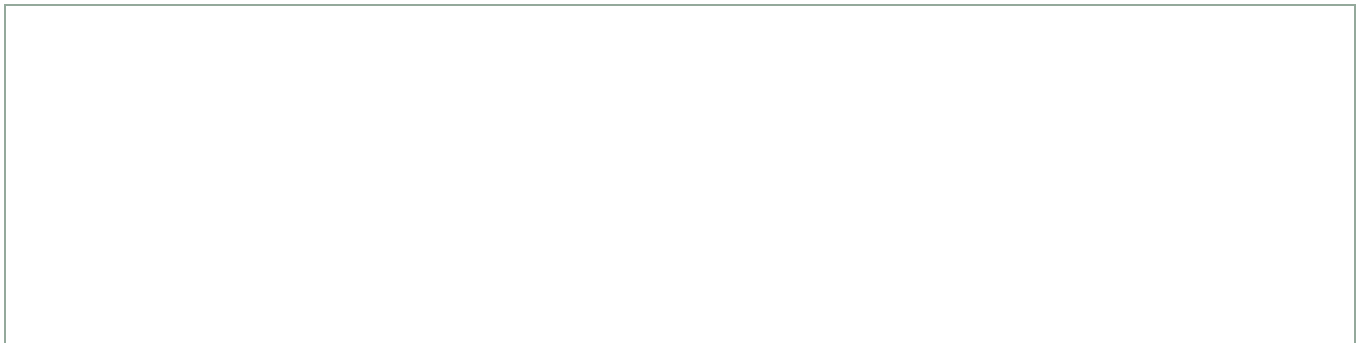


Check the notebook and ask for missing materials

Submit the labeled sample and written confound. Attach evidence from the PLTW task only after doing it. Ask the teacher for any missing task. Save the same work if submission is unavailable.

Use the correct enrolled-section route in P1. Review the labels and limits before submission; retain the later research-plan and weekly holds.

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



Check your product

- All three variable types are correctly identified in the sample.
- The comparison group, treatment-assignment unit and sample size are labeled.
- A written confounding example states the link, alternative explanation and repair.
- Follow the assigned PLTW task, submit it when ready and check its confirmation. Ask the teacher if you cannot open it.

Keep the limit: Original design-labeling practice only. It cannot establish a worm response, causal effect, clinical conclusion, representative sample, animal procedure or official task completion.

Turn in your work

Submit the labeled sample experiment and written confounding-variable example in your enrolled section: 1292 <https://clevelandmetro.schoology.com/assignment/8544585662> ; 6792 <https://clevelandmetro.schoology.com/assignment/8544585684> . Keep notes and evidence from the assigned PLTW work with the notebook; open the assignment to check access.

If access is unavailable, save the same notebook and tell the teacher. You can use the supplied practice alone. Request the official task, teacher packet and later research-plan inputs before using them.

[Section 1292: Wk12 Lab notebook: Variables and controls](#)

[Section 6792: Wk12 Lab notebook: Variables and controls](#)

Carry forward

Name what changes, what is measured and what stays consistent; count independent units and check for competing explanations.

Use the variable labels and confound repair to prepare an answerable April 9 research question; ask for the actual literature and official project inputs. How will your research question specify the variables and address the confound?

Sources and resources

[Open today's page](#)

NIST-DOE · What is experimental design?

National Institute of Standards and Technology

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

NIST-SAMPLE · Choosing a Sampling Scheme

National Institute of Standards and Technology

<https://www.itl.nist.gov/div898/handbook/ppc/section3/ppc332.htm>

NIST-UNIT · How can I account for nested variation (restricted randomization)?

National Institute of Standards and Technology

<https://www.itl.nist.gov/div898/handbook/pri/section5/pri55.htm>