

Wk12 Pre-lab: Research design and poster plan

Your goal: Design a *C. elegans* investigation and plan a research poster as a project team.

One product: Team research design plan: testable question, defined variables, target sample size, poster section outline, and assigned member roles.

Question: What evidence and protocol details must follow from a clear research question?

Start the work

1. Review the components of a strong research question.
2. As a team, draft a testable question about *C. elegans*.
3. Define your variables, controls, and target sample size.
4. Outline the poster sections you will need.
5. Assign each team member a poster responsibility.

If access is unavailable, save the same full solo draft and tell the teacher. Ask the group to review the proposed question and roles, and request teacher feedback and the official design prompt. Do not invent agreement or feedback.

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.

strain

A specified genetic line within an organism used in research.

batch

A set prepared or obtained together that may share conditions.

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 prediction or explanation with an explicit reason.

life stage

A defined period of development, such as larva or adult.

wild-type N2

A named *C. elegans* laboratory reference strain; it is not every wild worm.

adult cohort

The original group of adults enrolled at the stated starting point.

proportion

A part divided by its stated whole.

percent

A proportion multiplied by 100.

baseline

The stated condition used for comparison.

glucose

A simple sugar; the plan specifies the amount added to the medium.

medium

The material supporting culture in the proposed study.

protocol

Detailed, approved instructions for materials, measurements and procedures.

power

The probability of detecting a specified effect under stated design and analysis assumptions.

incubator

Equipment that maintains controlled environmental conditions.

poster outline

A plan for sections and the evidence each section will require.

role

An assigned responsibility with a named deliverable and input.

critique

A specific concern used to test or improve a plan.

mean

The sum of the measured values divided by their count.

caffeine

A chemical used here only as a hypothetical question variable.

larval stage

An immature developmental stage before adulthood.

loss

An enrolled organism that cannot be scored as planned; its status needs an explicit rule.

assay

A defined method for measuring a biological response.

survival

Remaining alive at the stated time under a defined scoring rule.

grams per liter

A mass concentration: grams of substance per liter of final medium.

milligrams per liter

A mass concentration: milligrams of substance per liter of final medium.

E1: from a broad question to a plan

April 7 separated the changed factor, measured response, consistent conditions and independent assignment unit. Keep that distinction when planning a new question; earlier official work is not assumed complete.

A question guides what evidence to collect. It does not supply a complete protocol. Another team also needs materials, timing, scoring rules, assignment and handling directions.

NIST describes advance planning of factors and measured responses. Valid experiments may study several factors. This introductory plan focuses on one assigned factor with possible competing explanations.

A broad question such as Does sugar affect worms? can start an inquiry. Narrow it before testing; broad wording alone does not make every possible measurement meaningless.

Use this frame: In [organism and life stage], does [factor with two levels] change [response with units] over [time]? Then list missing protocol details separately.

A glucose setting written only as 5 percent does not define its percentage basis. It is not a complete or validated protocol. S1 defines its own units explicitly.

E2: sample size and evidence limits

A treatment-assignment unit receives the condition independently in the design. If diet is assigned to a whole plate, worms within it are subsamples of that assignment.

More independent units can improve precision. More worms sharing a plate do not create more plate assignments. Larger counts do not remove systematic confounding or guarantee wider application.

NIST discusses nested observations and separate sizes of experimental units. Its sampling guidance separates precision from systematic errors that mix competing effects.

Name both the number of plates and worms. Explain why your target provides repeated plate-level comparisons, what resources limit it, and why adequacy still needs review.

No invented target here is a power calculation or approval to use animals. A real plan needs a justified sample size, suitable measurement method and ethical review under classroom rules.

E3: a real paper claim and how it was tested

Lee, Murphy and Kenyon reported a glucose-related lifespan decrease in *C. elegans* under their study conditions in 2009. This is a published finding, not our class result.

Their comparison added glucose to culture plates with growth medium and bacterial food. They compared survival with the baseline condition and varied when glucose exposure began.

Figure 1A reports shorter lifespan with added glucose. Figure 1B distinguishes adult exposure from exposure only during development. This shows why life stage belongs in the question.

For your literature note, write the claim, comparison method and adult-exposure distinction. Cite Lee et al., 2009, Figure 1A-B. Do not import their numerical outcomes into your planned results.

An extension hypothesis can use the direction this paper reported as its reason. Any prediction remains uncertain in a new setup.

The study does not establish a caffeine effect, a school experiment outcome or a human dietary recommendation. Its full methods are not supplied as a classroom protocol.

S1: complete original paper-planning scenario

Fictional planning case: consider wild-type N2 *C. elegans* beginning on day 1 of adulthood. Compare baseline medium with no added glucose against medium with 20 grams added D-glucose per liter.

Here 20 grams per liter means the final prepared medium would contain that added mass per final volume. This is a proposed paper setting, not a preparation recipe.

The proposed response is the proportion of the original adult cohort still alive on day 10 after assignment, reported as a percent for each plate.

Use alive original adults divided by original adults enrolled, times 100. Offspring are not part of that cohort. No survival counts are supplied; leave every result blank.

Plan 12 separate plates, six independently assigned to each condition, with 25 original adults per plate. Count the worms and the plate assignment units per condition separately.

Treat this target as a tentative resource assumption, not a biological minimum or power result. Your rationale explains what it allows and what limits it.

Use chance-based allocation of the two conditions across plates. Hold strain, starting age, adults per plate, bacterial food, base medium, planned 20 degrees Celsius and day 10 scoring time consistent.

Label the independent variable, the dependent variable with its units and the comparison group from the settings above.

Stress-test the plan: one incubator for each diet could confound diet with incubator. A real design must separate or account for chamber effects and validate actual temperatures.

The scoring method, adult identification, losses, offspring separation, materials and humane handling remain teacher-protocol inputs. Missing or lost animals cannot silently count as dead.

If a real approved protocol cannot track the original cohort, this response is not ready to measure. State that limitation instead of inventing a scoring method.

Use S1 to draft your own full question, variables, sample rationale and poster plan. You may revise a setting if you explain its effect and keep the plan coherent.

R1: poster outline with evidence requirements

This assignment uses five named sections: question, background, methods, results and conclusion. Poster formats vary; these are this class's planning sections, not a universal publishing rule.

Question: give organism, life stage, factor levels, response and time. It requires your approved final question, not an impressive title alone.

Background: explain the question's purpose and include the E3 claim, method and citation. Separate the published adult-lifespan finding from the untested day 10 prediction.

Methods: plan the control group, consistent conditions, assignment unit, sample count, scoring and analysis. Identify the actual protocol details you need from the teacher.

Results: reserve a table with plate ID, condition, original cohort count, alive original adults, losses and survival percent. Do not fill any value as an observation.

Plan a graph of each plate's survival percent by condition. Keep individual plate points visible; the axis labels are condition and day 10 survival percent.

Conclusion: reserve space for what the eventual data support, limitations and next steps. Write "No results are supplied." A hypothesis belongs before results, not as a pretend finding.

The present product is an outline with these evidence needs, not a finished scientific poster. Actual data, graph and conclusions remain unfinished until authorized work supplies them.

T1: team jobs, critique and solo recovery

Use four roles with no personal names in this draft. Role A owns question and background. Role B owns methods. Role C owns the results-table and graph plan.

Role D owns the conclusion placeholder, references check and final assembly. For a three-person team, combine Role C and Role D and record that change.

Each role records the section, concrete deliverable, input needed and next check. Ownership is a plan; it does not prove a real team member accepted the job.

Teacher or peer review asks: are the response and units clear, are plate counts separate from worm counts, and does the question still need protocol details?

Supplied solo critique: Your diet groups use separate incubators, so temperature or chamber could explain the difference. Your day 10 method also needs a rule for lost adults.

Write a revision or justified hold for both concerns. Label this supplied critique. Do not call it feedback from a real team or teacher.

If absent, inspect the actual project thread, adopt the real group's agreed question and claim a poster section when access is available.

If the group or thread is unavailable, complete the S1/R1 four-role draft alone. Ask the team to review the proposed question and roles; record only agreement or posts that actually occur.

C1: warmups, self-check and extension

Warmup 1 rewrites Is caffeine bad for worms? For paper practice only, use adult *C. elegans*, added caffeine 0 versus 1 milligram per liter, and mean movement speed after 24 hours.

Define that proposed speed as distance in millimeters divided by observation time in seconds. Ask whether the two conditions differ; no caffeine effect is supplied.

These fictional settings only make the wording inspectable. An actual caffeine study would still need an approved protocol, justified levels and a suitable observation method.

Warmup 2 names a needed research-team job. Use question/background, methods, results planning or assembly from T1, and state what that job must deliver.

Prerequisite: complete Does [changing X] change [measurable Y] in *C. elegans*? Then add life stage, levels, units and time using S1. The sentence still does not replace a protocol.

Self-check: narrow Does the environment change worms? Choose one environmental factor with two levels, one response with units, a starting stage and a time.

Label your factor and response. Then list the stage criteria, observations and protocol details that must still be supplied before testing.

For S1's extension, write a day 10 survival hypothesis that uses the adult lifespan direction in E3 as its reason. State why a fixed-day difference is not guaranteed.

The paper supports a reason for that hypothesis, not your future percentage or a finding that your experiment succeeded. Alternative predictions need an explicit reason and test.

P1: actual course work and submission

Today's class schedule asks for a Lesson 2.3 research question, design and poster outline in myPLTW. It may appear as a Problem 2.3.1 design-planning or team-project prompt.

Ask the teacher to identify the assigned screen and stopping point. Request the teacher-selected task and keep its evidence separate from this practice plan.

Do not assume April 7's variables activity is complete. Opening a page, drafting roles or finishing this outline does not justify checking off an official project.

The Toxic Relationships project includes environmental-toxicology research, hypothesis, control design, real data, errors, graph and scientific report using teacher-directed materials.

The actual Module II guide, Module II-A culture preparation, resources, rubric and safety directions remain required. No glucose, caffeine or temperature study is authorized by this packet.

The glucose planning example teaches design logic; it is not a replacement for an assigned heavy-metal or pesticide question in the official project.

This week's checklist still names the endocrine organizer, model and 2.2.1 evidence. Ask your teacher how that work fits with today's research planning.

The actual assigned literature excerpt and weekly teacher packet remain separate if specified. E3 provides a complete original claim/method input without claiming those materials were supplied.

No homework is due before this class, even though today's product is called a Pre-lab. If your team works asynchronously, record its actual question agreement and roles when available.

Keep unfinished endocrine, research-plan, poster and tracker evidence distinct. The next class, April 12, is literature work; do not invent completion of that later task.

Submit Wk12 Pre-lab: Research design and poster plan in your enrolled section. Section 1292: <https://clevelandmetro.schoology.com/assignment/8544586338> . Section 6792: <https://clevelandmetro.schoology.com/assignment/8544586363> .

Confirm live access. If unavailable, save the full original plan with actual team, thread and official-task holds. Preserve real classmate and teacher feedback when it becomes available.

M1: different worked paper-bridge plan

Fictional plan: compare flat and folded paper bridges using the same paper and span. Measure sag in millimeters under one stated load after 60 seconds.

Use 10 separate bridges, five assigned to each shape. The bridge is the assignment unit. Keep paper, span, load and measurement rule consistent.

Worked question: does fold shape change bridge sag in millimeters after 60 seconds under the same load? The actual load value and apparatus still need a protocol.

Worked poster outline: question names shape and sag; background states the design purpose; methods list units and conditions; results reserve a blank sag table.

The conclusion says "No results are supplied." No strength improvement is reported. Roles A/B/C/D own question-background, methods, table-graph and conclusion-assembly respectively.

Supplied critique: different paper thickness by shape would confound the comparison. Revision: use the same thickness and record the actual material before any test.

This model demonstrates a plan, critique and revision. It supplies no animal biology. Apply its organization to S1 and cite E3 for the biological reason.

Try the decision

Which statement belongs in the Results section of the S1 poster plan today?

- No results are supplied: reserve plate-level records and a survival-percent graph; do not invent class observations.
- Added glucose reduced our day 10 survival because the published paper found a shorter lifespan.
- Our 300 worms prove this sample size is sufficient for every expected effect.

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	Review E1 and C1 good/broad questions; answer both warmups and the prerequisite frame.
10–25 minutes	Draft the S1 question with the actual team or labeled solo route. Read E3 and M1; note the published claim and comparison method.
25–42 minutes	Define S1 variables, independent units and target sample rationale using E2. List the missing measurement and chamber controls.
42–58 minutes	Outline all five R1 poster sections and each evidence need, including blank results and planned graph.
58–70 minutes	Assign T1 responsibilities with deliverables and input needs; ask the proposed people to agree before assigning their roles.
70–80 minutes	Obtain peer feedback or answer T1 supplied critique, revise, self-check and submit. Add the extension if ready.

Your response record

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

Define a testable question

Read E1, answer both C1 warmups and complete the prerequisite frame. Distinguish a question from a full protocol.

State organism, life stage, factor levels, response units and time. Vague wording needs refinement, not a claim that every measurement is worthless.

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

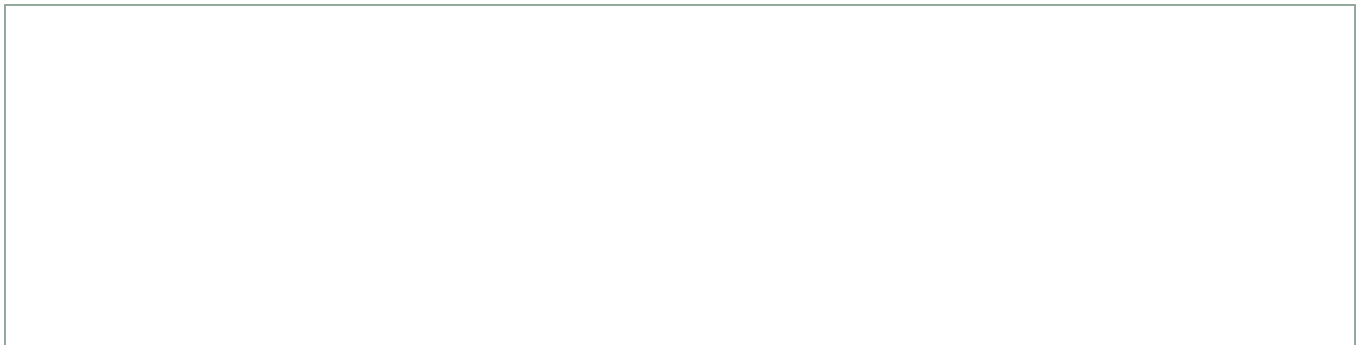


Draft the research question

With your actual team, or as a labeled solo draft, use S1 to write a complete question. Record the E3 claim, method and citation; inspect M1.

State a day 10 survival question without inventing counts or borrowing the paper's results as your own.

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



Define variables and sample rationale

Name the factor, two levels, response and units, control group, consistent conditions and independent unit. State target plates and worms and explain the tentative rationale and limitations.

Use E2 to count S1's plate assignments separately from its worms. Address incubator effects and missing scoring/loss rules before any real test.

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

Outline all five poster sections

Use R1 to outline question, background, methods, results and conclusion. State each section's needed evidence; reserve a blank table and graph plan.

Write "No results are supplied." Define plate ID, condition, original count, alive count, losses and survival percent fields without fabricating observations.

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 a drawing, table, or graph. It occupies the lower half of the page.

Assign responsibilities honestly

Use T1 to assign four roles, or combine C/D for three people. Record section, deliverable, needed input and next check. Retain actual group agreement and thread adoption holds when alone.

A draft allocation does not prove a real teammate accepted a job. Async and missed-team remediation require the actual group/thread when available.

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

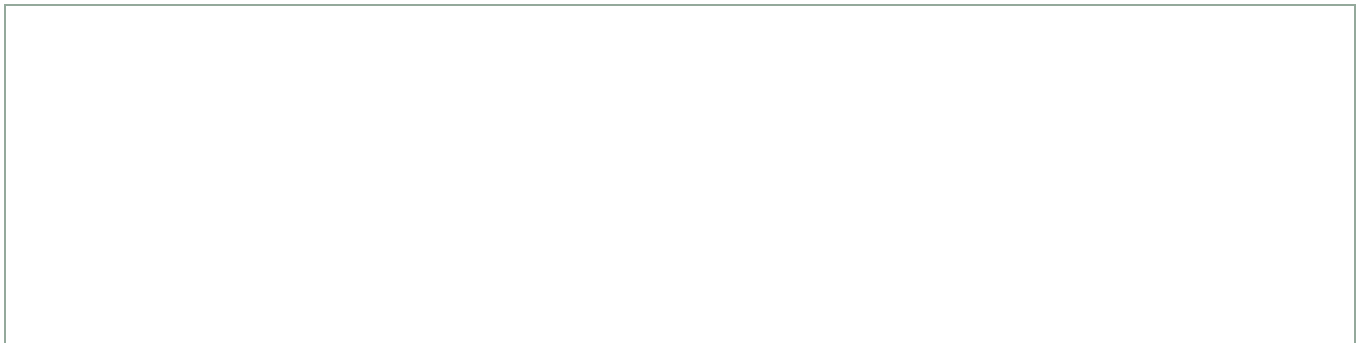


Critique, revise and submit

Share with another actual team or use the supplied T1 critique. Address both incubator and loss-rule concerns, answer C1's self-check, and add the conditional extension if ready. Submit the full plan.

Record actual feedback or label supplied critique. Preserve teacher approval, exact official prompt and missing protocol holds; use the correct section route.

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

- Team produces a testable question with defined variables.
- Poster plan assigns clear roles and sections.
- The target names independent units and a tentative rationale with limitations.
- Leave results blank until actual data are supplied. Record only team decisions that occur and use evidence from the assigned official task.

Keep the limit: Original paper research/poster plan only. Published findings support a bounded hypothesis. They cannot establish class outcomes, adequate power, human advice, animal authorization or official project completion.

Turn in your work

Submit the full research design plan through your enrolled section:1292

<https://clevelandmetro.schoology.com/assignment/8544586338> ;6792

<https://clevelandmetro.schoology.com/assignment/8544586363> . Open the assignment to check access.

Keep the question, variables, sample rationale, poster outline and agreed roles together.

If access is unavailable, save the same full solo draft and tell the teacher. Ask the group to review the proposed question and roles, and request teacher feedback and the official design prompt. Do not invent agreement or feedback.

[Section 1292: Wk12 Pre-lab: Research design and poster plan](#)

[Section 6792: Wk12 Pre-lab: Research design and poster plan](#)

Carry forward

A precise question guides the plan; defined units, methods and evidence needs make the plan ready for review.

Use the plan to judge which literature claim and method matter next; ask for the actual data and official-task directions. Which literature method is relevant to the question in your plan?

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>

LEE-2009 · Glucose Shortens the Life Span of C. elegans by Downregulating DAF-16/FOXO Activity and Aquaporin Gene Expression

Lee, Murphy and Kenyon, Cell Metabolism 10,379-391 (2009), DOI10.1016/j.cmet.2009.10.003; author-hosted primary paper

https://murphylab.princeton.edu/sites/g/files/toruqf1986/files/2009_cell_metabolism_lee.pdf