Pioneering the Future

Problem 4.3.1. The course capstone. Chart the direction of your own lab

The biggest thing in PBS. Innovation, Inc. has offered you a job and open lab space, and it is yours to point somewhere. You define the research focus, define the problem, choose a solution, hire the team, lay out the lab, and write the plans for testing and evaluating what you build.

WORTH 10 POINTS | DOES NOT HELP ON THE WEBXAM | TEAM PROJECT ACROSS SEVERAL SITTINGS | ABOUT 4 TO 5 HOURS

What this is and why it is worth doing

You have finished the internship. The Emerging Markets division has open lab space and wants a team to chart the direction of the new lab. The lab starts with one research focus, and your team defines it.

THE HONEST NOTE, AND IT CUTS BOTH WAYS

This will not help you on the WebXam. WebXam 072110 weighs handling, preparation, storage and disposal, and biotechnology research and experiments. Problem 4.3.1 writes a testing plan and an evaluation plan and then executes neither. Planning an experiment you never run does not feed a domain that is about running them.

And it is the best synthesis task in the course, and at 10 points it carries more weight than any other item in this pack. You define your own problem, write your own criteria and constraints, choose between your own ideas with a matrix, and pull in everything you have learned all year: body systems, vital signs, lab tests, genetic testing, infectious disease, emergency care. It is the closest thing in PBS to what the actual work is.

If your semester goal is an exam score, this is the last item to pick. If you are trying to find out whether you want to do this for a living, it is the first.

How long it takes and what you need first

- **About 4 to 5 hours across several sittings.** This is not a one-evening item and pretending otherwise produces a thin proposal.
- **A team.** This one really is better with three or four people, because part of what is assessed is how the team worked. Alone is allowed and you say so.
- **Sticky notes** for the brainwriting session.
- **Optional model materials:** recycled cardboard, recycled plastics, foam board, tape, glue, found materials.
- The **Problem 4.3.1 Rubric** from Mr. Mendoza. Read it first.
- Something to build a presentation in. Slides, a story map, a Tinkercad presentation, an annotated design process graphic, or anything else you can defend.

What goes in the lab proposal

SECTION	WHAT IT CONTAINS
A description of the research focus	The overarching goal of your new lab.
A defined problem	One problem the whole lab will work on, and a design brief for it.
One identified solution	Sketched or modelled.
An assembled team	The additional expertise you need to succeed.
A designed lab space	Laid out and equipped.
A demonstration of the process	Your strategy for testing and evaluating the solution, plus a user or patient story showing the impact on a real life.

The steps

1. Form your team. Each person shares their talents and skills, **and at least one area they feel less strong in**. Then evaluate the team's strengths and weaknesses together. Document both, because you will use it when assigning jobs.

   Done when: a written record exists of every member's strengths and at least one weakness each.

2. Establish **team norms**: shared agreements about how you will work. Brainstorm guidelines, narrow to a draft set, discuss what each one looks and sounds like when it is being followed, discuss what you will do when one is not, and write the final set down.

   Done when: a written set of norms exists including what happens when one is broken.

3. Individually, think about a problem the new lab could address. Then run a **brainwriting** session: sit in a circle, everyone gets five to ten sticky notes, everyone silently writes or sketches one idea per note, then passes it right. When you receive a note you may use it to spark a new idea on a fresh note, annotate a modification directly on it, or pass it on. Keep going silently until time is called.

   Done when: a pile of notes exists, many of them annotated by more than one person.

   Ideas can be as broad as diabetes or as narrow as a pill-based therapeutic for patients with traumatic brain injury. Both are valid starting points.

4. Run a peer feedback discussion on the notes. The goal is actionable, constructive evaluation of each idea, not applause.

   Done when: every idea that survived has written feedback on it.

5. Choose your research focus by consensus. A decision matrix helps. If you disagree, work through *we all agree that* and *where we seem to disagree is*.

   Done when: one focus is chosen and the reasoning is recorded.

6. Brainstorm potential problems inside that focus, **posed as questions**. Then choose one by consensus.

   Done when: one problem question is chosen.

7. Research it properly. Books, professional journals, podcasts, personal interviews, patent searches. Document everything in APA style. Then do two specific things: **validate** the problem by showing that credible sources agree it is a problem, and **justify** that it is worth the time and effort to solve.

   Done when: validation and justification are written separately, each with sources.

8. Write a design brief with measurable criteria and constraints, and a **problem statement**. Check it against the characteristics in the box below.

   Done when: the problem statement passes every check in the box.

9. Individually brainstorm at least two potential solutions each, then share. As a team, select one using a decision matrix.

   Done when: every member contributed at least two solutions and the matrix is complete.

10. Create a sketch or a model of your chosen solution.

    Done when: a sketch or physical model exists.

11. List the careers you have met in this course. Then choose **five additional professionals** to bring on board and describe the role each takes. An oncologist for cancer? A computer programmer to model and test? A biotechnologist to develop a therapeutic?

    Done when: five professionals are named with a specific role each, tied to your problem.

12. Work out the equipment your lab needs, including things Innovation, Inc. may already have and new purchases targeted at your focus. Then sketch the lab layout, documenting potential hazard areas, equipment locations, entry and exit points, team collaboration areas, individual workstations, and traffic flow.

    Done when: all six elements are labelled on the layout.

13. **Write the testing plan.** What are you trying to find out and what needs to be tested? How will the testing be performed? Where? How long will it take? Who needs to be involved?

    Done when: all five questions are answered specifically.

14. **Write the evaluation plan.** If your solution works, what does success look like? Be concrete.

    Done when: success is described as something observable, not as a feeling.

15. Create a **fictional patient profile** showing the impact your solution has on one life. Draw on everything from the course: body systems, vital signs, lab tests, genetic testing, infectious disease, emergency care and stabilisation. Describe this person's life before and after.

    Done when: the profile names specific clinical detail and shows a before and an after.

16. Build the presentation documenting the whole proposal, in whatever format you choose, covering every item on the checklist. Then present it to the Emerging Markets division.

    Done when: every checklist item appears in the presentation.

CHARACTERISTICS OF A GOOD PROBLEM STATEMENT. CHECK YOURS AGAINST ALL FIVE

- It is **concise**.
- It **leaves room for multiple solutions** and does not imply one.
- It is **specific enough to be solvable** in the time and with the resources available.
- It answers: who has the problem, what exactly it is, where it exists, when it has happened and for how long, and how prevalent it is with statistics.
- It answers: **is the problem valid**, meaning who else says it is a problem.

An acceptable problem is one with no known solution, or one whose existing solution can be significantly improved. It must be valid and it must be justifiable, meaning the effort to solve it is warranted by the need and the cost.

WORKED EXAMPLE. A PROBLEM STATEMENT REWRITTEN THREE TIMES. INVENTED, NOT A FOCUS YOU HAVE TO USE

> **Version 1.** "We will design an app that reminds elderly patients to take their medication."
>
> That is not a problem statement, it is a solution statement. It names the answer in the first eight words, which shuts down every other approach before anyone has thought of one. It also has no who, no where, no scale and no validation.
>
> **Version 2.** "Elderly patients often forget their medication, which is a serious problem."
>
> Better, in that it no longer implies a solution. Still unusable. *Often* is not a number, *elderly* is not a defined group, *serious* is an assertion with nobody behind it, and there is no where and no how long.
>
> **Version 3.** "Adults over 65 living independently and taking four or more daily prescriptions miss doses at a rate their own physicians describe as the leading avoidable cause of preventable hospital readmission in this group. The problem is longstanding, it grows as the number of concurrent prescriptions rises, and existing approaches, printed schedules and pill organisers, have been available for decades without closing the gap. How might dose adherence be improved for this population without adding cost or requiring a caregiver to be present?"
>
> That version names who, what, where, how long and how prevalent, states what has already been tried and failed, cites who says it is a problem, and ends with a question that a dozen different solutions could answer. An app is one of them. So is packaging, so is a pharmacy process change, so is a change to how prescriptions are timed. That is what leaving room for multiple solutions means.
>
> Every statistic in version 3 would need a real citation in a real proposal. The numbers here are illustrative.

What finished looks like

The full lab proposal, containing every one of these.

1. Team strengths and weaknesses, and your written team norms.
2. The brainwriting record, including annotated notes and the peer feedback.
3. The research focus, with the reasoning that chose it.

4. Your research with APA citations, plus separate written validation and justification of the problem.
5. The design brief, with measurable criteria and constraints, and the problem statement.
6. The decision matrix and the chosen solution, sketched or modelled.
7. Five additional professionals with their roles.
8. The lab layout with all six required elements labelled.
9. The testing plan and the evaluation plan.
0. The fictional patient profile, before and after.
1. The presentation itself.
2. Four reflection answers: the ethical, social, moral and legal impact of your lab's work; how your team showed positive interdependence with specific examples; what advice you would give yourself if you started this unit again; and what your career aspirations are now, and why.

> **POSITIVE INTERDEPENDENCE, WHICH THE REFLECTION ASKS ABOUT**
>
> It means each team member recognises that their own success depends on their teammates succeeding. Everyone contributes something unique and everyone supports the others, which requires each person to know their own strengths and their own weaknesses. That is why step 1 asks you to name a weakness out loud. Strong teams know their limits and work on them rather than hiding them.

Where people get stuck

A problem statement that names the solution.

The most common failure by a distance. If your statement contains an app, a device or a program, it is a solution statement. Rewrite until every reasonable approach is still on the table.

Criteria that cannot be measured.

Criteria are what a successful solution must do, and each one has to be measurable. If you cannot say how you would measure it, it is a hope.

Skipping validation.

Showing that credible sources agree it is a problem is a separate, graded step from saying it is a problem. Cite somebody other than yourselves.

A generic patient profile.

"A 45 year old man who feels better after treatment" uses none of what you learned this year. Put real clinical detail in: vital signs, lab values, a genetic test result, a body system that was failing and now is not.

An evaluation plan that says "we would see if it works".

Say what success looks like as something you could observe or count, and say what number or observation would make you conclude it had not worked.

A lab layout missing hazard areas.

Six elements are required and hazard areas is the one that gets left off. It is also the one a real lab designer starts from.

Team norms written and then never used.

The norms are graded partly on whether you actually applied them. If a disagreement happened and a norm resolved it, that is exactly what the reflection wants.

Talking during brainwriting.

It is silent on purpose. Silence is what stops the loudest person's first idea from becoming the team's only idea.

Leaving it to one sitting.

Four to five hours of work compressed into one evening produces a proposal that looks like it. Book three sessions.

How to submit and how it is credited

THIS ITEM IS WORTH 10 POINTS

Twelve deliverables making up one lab proposal. It is the largest single item in the pack and the highest paid, at half the semester cap. On a team the 10 points are per person, and what gets credited is your own pages and your own reflection. Remember the 20 point per semester cap across all extra credit.

- **Where it goes.** The same place as everything else. Your class form on the portal, or handed to Mr. Mendoza in person. Nothing about extra credit needs a different route.
- **What to hand in.** Photographs of your work where the handout asks for them, plus your written pages. Photographs of handwritten pages are fine. A photograph you cannot read is not.
- **Put your name and period on every page and every photograph filename.** Unlabelled work cannot be credited and it is the single most common way points get lost.
- **When.** Any day after the pack opens, right up to the last week of the semester. There is no deadline inside that window and no penalty for going slowly.
- **Feedback.** You get it back with a note. If a piece is short of full credit you may fix the named thing and resubmit once.

Words this activity uses

Team

A collection of individuals brought together to accomplish a common goal.

Team norms

Shared agreements about how a group will work together: how people treat each other, how the group engages with hard content, and how disagreements are handled.

Positive interdependence

Each member recognising that their own success depends on their teammates succeeding.

Brainwriting

A silent brainstorming technique where ideas are written on notes and passed around, so everyone contributes equally and nobody's voice dominates.

Consensus-building technique

A method for reaching a decision a group can live with, such as a decision matrix or working through what you agree and disagree on explicitly.

Research focus

The overarching goal that guides everything a lab chooses to work on.

Problem statement

A concise statement of the problem that leaves room for multiple solutions and does not imply one.

Criteria

What a solution must do to succeed. Measurable.

Constraint

A limitation on the design: time, money, expertise, equipment.

Decision matrix

A table evaluating several options against the same criteria to produce a comparable overall rating for each.

Design process

The six-step iterative strategy Innovation, Inc. uses: define the problem, generate concepts, develop a solution, construct, test and evaluate, and present.

Traffic flow

How people move through a space. A real constraint on how a lab is laid out.