

Scientific Proposal Writing

BIOENG-458 - Next-generation Biomaterials Spring 2025

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1. Timeline:

Step 1:

Introducing topics and open for signing up: by **28th February, E1**

Step 2:

Group formation (5 students per group, 21 groups): form groups based on interest on topics. Sign up in moodle for topics, first come, first serve; those who hasn't chosen topics after **7th March** will be randomly assigned

Step 3:

1-page outline due: **11th April, E7; submission to Moodle**

Step 4:

Final written proposal due: **23:59, 22nd May; submission to Moodle**

Step 5:

Final presentation: 10' presentation+5' Q/A/group, on **L12 and L13 (23rd and 30th May)**
(L11-16th May): Workshop to prepare report/presentation)

2. Group Project

One goal of this course is to develop skills in integrating concepts covering the many facets of tissue engineering and bridging biology and engineering thinking. To give you exposure to this challenge, we will have a group project this semester. The students assemble themselves into teams of 5 with similar interests to choose one from a list of topics/challenges. The teachers and TAs will introduce the topics. Your team will carry out research on the background and needs for your chosen target application and develop a design for a novel approach to solve the selected problem. We will have a number of exercise sessions of in-class time for you to work with your team and to have consulting sessions with the TAs for guidance on your research. A final integrated written project proposal will also be due before the final presentations. In a final class, each team will give a complete presentation summarizing the design research;

3. Components of the Project

Together all team members will develop the overall project and coordinate efforts as a team. Then, each team will assign group members to focus on researching specific components of your overall design, that will ultimately become part of your in-class presentations. The components of your project will address:

- Problem summary and background
 - What is the specific clinical or engineering problem you are aiming to address? What are the unmet need, issues to be addressed? What is the current state of the art? What are the current solutions that have been developed by others? What are your objectives with your intervention/invention? (**well define a specific issue to address is the first and probably the most important step; if the scope is vague and too broad, you unlikely will develop a good proposal**)
- Design rationale/overall concept
 - What approach will you use and why? How will your system work?
 - What prior studies motivated your design the idea?
- System creation/synthesis
 - How will you develop your methods? (use 3-4 specific aims to plan to investigations step by step)
 - What experiments do you plan to do and what methods can you use?
 - What might go wrong, or what design aspects need to be tested empirically to know if you design will work? What alternatives can you pursue if you run into your predicted problems?
- Design testing
 - How will you test your design? What experiments are needed to evaluate the concept?
 - What are the criteria for success in your device/design?

4. Template for 1-page outline

- 1) An abstract including the following points:
 - a) A brief description of the project area
 - b) A brief description of the state of the art in this area
 - c) A brief description of one major challenge in this area that you want to address in this proposal
 - d) A brief description of your ideas (a new technology, method, approach, application, etc) to address the above mentioned challenge
 - e) the novelty and advantage of your idea
 - f) what is the clinical relevance (why/how it can impact the real clinical applications)
- 2) Specific aims (list at least 3-4 specific aims you want to achieve in this design project [1-2 sentence for each aim])

Notes: specific aims need to be “specific”: what exactly you plan to do? (is it feasible, if yes, based on what knowledge/technology)

 - Usually start with a verb “To investigate/examine/prepare/engineer/test/evaluate/develop/xxx”
 - Steps (sequential) Or directions (parallel)
 - Brief rationale should be described

5. Final Project Report

A final report will be due, which will collate the efforts of your entire team. Each team member should take ownership of a section(s) of this report based on the breakdown of assignments to the different sections (a structure similar as “**Components of the Project**”). Each section should have a leading author who will contribute 2-3 pages (including figures) to the overall report, and also 1 team member should be responsible for serving as master editors to ensure

your overall document reads in one voice as an integrated report. **The contribution of each team member should be identified clearly in the report.**

Schematics and figures from the literature should be included to support key ideas (with appropriate citation to the literature).

Final report formatting instructions:

- Left and right margins 2.54 cm, top and bottom 2.54 cm, single-spaced
- Arial 11 pt. font
- Minimum 2 pages maximum 3 pages (main text + figure) per team member (with page numbers)
- You may either create your own figures or use figures from the literature, where appropriate. Be sure to properly indicate the citations for any figures you did not create!
- Please be sure to cite all literature in your proposal in a standard format and be consistent (pick any format from a good journal, for example, *Nature*, *Science*; must be acceptable in professional scientific journals). Please collect citations at the end. Citations do not count towards your page limit.
- In the title page, please include a statement which team member worked on what portion of the proposal

Suggested proposal outline

- 1) Summary (1 page): abstract + specific aims
- 2) Background and general ideas:
 - a) A brief description of the project area
 - b) A brief description of the state of the art in this area (what is known)
 - c) A brief description of one major challenge in this area that you want to address in this proposal
 - d) A description of the previous work done/approaches tried in the area
 - e) A brief description of your ideas (a new technology, method, approach, application, etc) to address the above mentioned challenge
 - e) the novelty and advantage of your idea
- 3) Innovation and impact statement: Describing why what you are proposing is new and impactful
- 4) Experimental approach: likely ~3-4 specific aims, describing what you would try and why, what experiments and controls would need to be done, what the potential pitfalls are, and what may be ways around them. **The main body of the proposal is structured by these specific aims.**
- 5) Future direction/pathway to the clinic section: what would need to be found in the clinic? What diseases and conditions would be treated with the new technology? What is known about the IP landscape?
- 6) Collected references (not counting towards the page limit; the format must be correct and consistent)

Note: While your proposal should roughly follow this format (and should always include an abstract, specific aims page, background, proposed experiments, and references), your proposal may vary in length, ordering, or sub-sections. You may also include other sections/subsections if you think them important for your proposal. Feel free to ask us if you have any questions.

6. Final Presentation

At the final class, each team will present to the class, in a 15-minute presentation (10' presentation+5' Q/A), a summary of your group project. Each team member should present part of the project.

For the in-class presentation, we will be looking for how well your presentation addresses the questions listed above under **Components of the Project**, the depth of your analysis, and your discussion points during the Q&A after the presentation. Each team will receive a team grade for the final presentation.

7. Grading rubric for final presentations and reports

Topic (20%): Is the chosen topic area well-defined and impactful? Is the chosen approach to address the topic novel, appropriate, and feasible?

Research content (60%):

Background/understanding of the field: Does the proposal explain the topic area and the need for a new approach? Does the proposal show good understanding of the phenomena, processes, and challenges involved with the proposed approach?

Previous work/IP: Does the proposal show a good understanding of the previous work conducted to try to address your topic? Does the proposal clearly explain how your approach differs from/improves upon what has already been demonstrated?

Experimental plan: Are the proposed experiments reasonable and well controlled? Is there good explanation for how the results will inform the rest of the proposal? Is there explanation for how results will be interpreted, what challenges may be encountered, and what can be done to overcome them?

Clarity/style (10%) – Is the proposal written in a manner that is easy to understand, with few errors? If figures are used, are they clear, and add to the clarity and comprehension of the proposal?

Formatting (10%) – Is the proposal formatted correctly as per the stated criteria? Is the proposal appropriately referenced? Is the format of reference citation correct and consistent?