

**Research Proposal**

**Contact Information:**

**Date:**

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**Write Company Name here**

Address Here / Phone: 000-000-000 / www.abc@gmail.com

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**Table of Contents**

[Letter of Transmittal: 3](#_Toc104921096)

[Project summary 3](#_Toc104921097)

[Specific Aims 4](#_Toc104921098)

[Background and Significance: 4](#_Toc104921099)

[Preliminary Results: 5](#_Toc104921100)

[Research Plan: 5](#_Toc104921101)

[Acknowledgements: 6](#_Toc104921102)

[References: 6](#_Toc104921103)

[Qualifications of the Research Group: 6](#_Toc104921104)

[Budget: 7](#_Toc104921105)

[Budget Justification: 7](#_Toc104921106)

[Research Facilities: 7](#_Toc104921107)

[Miscellaneous: 7](#_Toc104921108)

Final Research Project Proposal

## **Letter of Transmittal:**

This identifies the proposal so that it will be sent to the correct reviewers in the agency at which it is being considered. A letter of transmittal will contain:

*Contact information* – where can you be reached for questions. Include name, address, phone number, FAX number, email address. (You may omit any information that you do not feel comfortable to release. Remember that these reports will be on file for other students in future years).

*The date of submission*.

*Name and business address of the person to whom the proposal is being transmitted* – In this case it will be: Steven A. Jones, Associate Professor, Biomedical Engineering Program, Louisiana Tech University, P.O. Box 10348, Ruston, LA 71272.

*A statement that you are submitting this proposal for review*, including the title of the proposal and what it is being reviewed for (Final Research Proposal for the Research Experiences for Undergraduates Program).

*Any additional information* that you believe will help support your proposal. Note: be brief.

*Expression of gratitude* for the addressee’s effort and for that of the reviewers.

*Closing, signature, and your name (typed).*

1. Title Page: This provides the reviewers with important information that he/she can reference quickly. Include:
2. Your institutional affiliation (Louisiana Tech University, Biomedical Engineering Program).
3. The title of your proposal. This should be descriptive of your project. Do not use a title like, “REU Project Proposal.”
4. Your name.
5. The date of transmittal.
6. The statement: Final research proposal presented to Dr. Steven A. Jones in partial fulfillment of the requirements for the Research Experiences for Undergraduates program.
7. Table of contents. Section headings must be included, along with the page numbers on which these sections begin.

List of figures and list of tables. Include figure/table captions and page numbers.

## **Project summary**

This must be *no longer than ½ page in length (250 words)*. Include 1) The major problem you intend to address and why it is important, 2) The specific aspect of the problem that you will address, 3) A statement of how this problem will be addressed, 4) Indications from your proposal as to how you evaluated the feasibility of the project. 5) A statement of the project’s feasibility. 6) The expected benefits of the project. The summary should be 1 to 2 paragraphs long. It will probably be the first part of the proposal that the reviewer reads, and he may use it as an initial screening when he has to review a number of different projects. The summary can slant the reviewer’s attitude toward your entire proposal, and conceivably the rest of your proposal may never be read if the funding agency has large competition and if the summary is poor, so it is highly important that your summary be straightforward and clear. Generally, this section does not include figures.

**Specific Aims**: This section is intended to tell the reader specifically what you plan to do and how you plan to do it. *This section must be no longer than 1.25 pages (500 words max).* Generally, this section does not need to include figures or a large amount of explanation because the reader knows that you will elaborate on what you say in the Background section. A good form to take in your Specific Aims section is:

1. Identify the general problem you are trying to solve.
2. State the specific hypotheses or research questions you are trying to answer.
3. State each objective or experiment that you intend to carry out to answer your hypotheses. It is highly recommended that if you have 3 hypotheses, you should have 3 objectives, each of which matches up with a stated hypothesis.
4. State in what way the accomplishments of the objectives will address the hypotheses.
5. State what impact the results of each hypothesis will have on the general problem.

Try not to make it obvious that you are following this as a “formula.” Parts a-f must hold together cohesively, not be separate items that you “have to get in.” The argument you make above will be expanded in the Background and Significance section. Provide authoritative references.

## Background and Significance:

The background has both major purposes and minor purposes. The primary purposes are: 1) To give the reviewer enough information that he/she can understand what will follow. 2) To establish in detail the importance of the problem 3) To show that there is a need to solve the problem. 4) To demonstrate that the problem has not yet been solved. 5) To show that the direction you propose is the next logical step in the evolution of the solution. The minor purposes are to 1) To demonstrate a high likelihood of the project working and 2) To demonstrate that you are knowledgeable about the subject. Generally, you *do not* show that you have expertise by adding irrelevant information in this section. Rather you show your understanding through a cohesive argument that addresses the primary purposes. When this is done, the reviewer will be convinced of your competency. Think carefully about what information is and is not needed. If you are working on a question that is expected to be useful for total knee replacements, for example, it is appropriate to list for the reviewer several reasons why people need knee replacements and give figures as to the prevalence of each one. If your project addresses a specific disease that requires a specific type of replacement, you will need to explain what is different about that disease and what the problems are. However, it is *not* appropriate to give a complete description about the pathological processes involved in each knee-degenerating disease. Under the major heading of Background and Significance you should use the following sub-headings:

1. Background: Tell the reader what he/she needs to know to understand the rest of the proposal.
2. Analysis of Need: This section will convince the reader that what you propose to do is reasonable and necessary. It will consist of the following subsections.
3. The Overall Need: Provide a logical argument which states the problem, justifies that it *is* a problem, and states why the research you propose is needed?
4. Current Status: Describe research that has been done in this area and that has led to the specific question you are attempting to answer. Describe why data from other investigators may be ambiguous with respect to the question. State how the information in the literature leads to the conclusion that the hypotheses or questions you have raised in the Specific Aims section have not been answered yet and yet are important to the progress of the field.
5. Enabling Technology: Give a reason why the atmosphere is now right to address that aspect (for example, through some technological aspect, change in attitudes of society, etc.). This is important. A reviewer will be skeptical if your idea seems to come from nowhere and will not believe that you happened to come up with an idea that nobody has ever thought of before. The immediate reaction will be either 1) someone has probably done it already or 2) someone has tried it and it turned out not to work. However, if you say that Michelangelo, Isaac Newton and Albert Einstein all thought about it but they did not have the technology available to them to carry it out at that time, it is much easier to convince the reviewer that you are taking the logical next step in the evolution of the problem.
6. Problem to be Solved: Having reviewed what is available in part ii above, determine what central aspect is missing from all of the current solutions. This aspect will be the specific problem you will address, and it should follow logically from the problems that have been shown to exist with other current solutions. Provide a direct statement of this problem, as in, “The proposed project will determine whether pH affects the incorporation of quantum dots

into protein coatings constructed through layer-by-layer assembly. The pH will be varied from 2 to 13 and the quantum dot incorporation will be measured directly through the intensity of the emission spectrum under a standardized excitation.”

It is critical that the subsections of the Background and Significance section be supported by current literature references. References from the world wide web, though often useful, are not sufficient to show that you have made a thorough study of the literature. Refereed journal articles must make up the bulk of your references for your argument to be convincing.

## Preliminary Results:

This section will, to some extent, support the major purposes of the Background and Significance section, however, its major purposes are to show 1) That the project you propose has a strong likelihood of success, based on some *preliminary experiments that you have done* (feasibility), 2) That your group has some expertise in the field (either through experiments, surveys of patients, or contact with experts in the field). *Information gained through a literature review should not go in this section, nor should you try to show your expertise by stating that you have reviewed the literature extensively.* Because you will have worked for almost 10 weeks on your project, you should have at least some results to report. Even if you do not consider your results to be earth shattering, include them as preliminary results.

## Research Plan:

This section is designed to convince the reader that you have an idea as to how to proceed and that your plan is organized and feasible. Subheadings of this section will be:

1. Detailed experimental design: Give a detailed description for the experimental design you select. You must have a figure that illustrates the experimental apparatus design. Don’t even think about turning your proposal in without this figure.
2. Experimental protocols: Be specific about experiments you will run and the data that you will collect. State what question each experiment is designed to answer. Be as detailed as possible, including such information as buffers and reagents, types of fluorophores, and incubation times.
3. Theoretical development: You should have some kind of mathematical analysis that is related to your research project. If such an analysis does not come immediately to mind, consider taking some time to consider how mathematical modeling might be useful. Often the value of a good analysis is not obvious a priori.
4. Statistical Analysis: What statistical tests for significance (e.g., T-test, F-test, Chi-Squared test, Pierson’s test) will you use to evaluate the results of your measurements for significance?
5. Organizational Structure and Schedule: State how the project will be divided up among the research team. If you need expertise in a particular area (e.g., mechanical engineering, electrical engineering, etc.) state this and give the role of the expert in that area. Use the precedence matrix to show that your time plan makes sense. Give a time-table of specific landmarks in your research and display these in a *Gantt chart*. Do not make this general (e.g., project definition, evaluation of solution, etc.), but be specific about your project (e.g., selection of knee material, machining of joint, etc.).

## Acknowledgements:

Few projects can ever be done without the help of others. In your acknowledgements name each person who has helped you, with a brief statement of what their contribution was. *Use complete sentences.* Likely candidates for this section are your sophomore assistant, professors with whom you have consulted, people who have personal experience with your problem (although subjects who participate in surveys that are quoted in your paper should remain confidential), and experts in the field whom you have contacted. Do not acknowledge anyone who is listed on the title page of your proposal or report. They are already acknowledged on the title page.

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## References:

*Any reference that is listed in this section must be cited in the text of your proposal.* You should use references primarily to back up specific statements you make throughout the proposal. Cite references with the (author, date) format. For example, “Nussbaum et al. (1990) states that …,” or “Myocardial infarction is the result of coronary artery thrombosis (Nussbaum et al., 1990).” Remember that “et al.” is an abbreviation for “et alii,” so there is a period after al., but not after et. Cite your references as: Author List, Date, “Title”, Journal, Volume, Page Range, and alphabetize them at the end of your paper. You will always include the range of pages which comprise the article. In the main body of your text, you will cite a specific page number *only* if you are taking a direct quote from the article. However, *you should almost never need to quote an article directly*. I suggest quoting an article directly only if you are quoting something that is a matter of opinion by the author of that article. Otherwise, paraphrase. There is a reason for this. The way you state something is always dependent on the context in which you are writing. The context of someone else’s work will almost never be the same as the context of your work. Therefore, use of someone else’s phrasing will always seem a little out of place and will distract from the point you are trying to make. Your citations should be mainly journal articles with occasional references to published proceedings or abstracts. *References to the world wide web are not to be used!* Instead, you must find an alternative sources for the statement you wish to cite. There are two good reasons for this requirement. 1) Web pages are not refereed, so there is no immediate way of determining their truthfulness. 2) Web pages are volatile. If someone goes back to the same site 1 year from now (or even earlier) there is no guarantee that the same information will be there. Also, refer to *recent* journal articles. If you are trying to establish that something has not yet been addressed, but your most recent article is 1996, your argument is not valid. Ongoing project development will require you to continue to search the literature for new work in your area. *You will never be “finished with” your literature search as long as you continue to work on the project.*

## Qualifications of the Research Group:

State who will work on this project and their qualifications. This will include you as the principal investigator. Please specify what special experience you have to work on this project. This section will also include other people who you know will be working on the project (e.g., your sophomore assistant). Since you do not know in advance everyone who will be involved, specify the other people by their qualifications. For example, “A biomedical engineer with a concentration in electrical engineering will be needed to perform ….”

## Budget:

State the cost of this project in the following terms: 1) Personnel (in most cases this will be zero cost since the students will be donating their time). 2) Supplies. 3) Travel. 4) Equipment 5) Other costs. It is likely that supplies will be the largest category, and in many cases the only category that is non-zero.

## Budget Justification:

Any costs specified in the budget section must be justified. You should also specify anything that may be considered “matching funds,” such as the time donated by yourself and your fellow students.

## Research Facilities:

State what facilities you will have available to you for this project and how they will be used. If someone has stated that they will provide a piece of equipment for your use, include that. This may include instrumentation from the undergraduate laboratory, equipment committed to the project by one of your professors, or equipment that you will be able to borrow from someone outside of the university. But be specific. Do not just say that such-and-such laboratory will be used. *State what equipment will be used from that laboratory and why it is needed for this project.*

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## Miscellaneous:

Use good grammar, spelling and organization. These aspects are paramount in convincing your audience that you have the necessary competence to carry out your work. Make your report as easy to read for a reviewer as possible. Make tables and figures as complete as possible. Do not make the reviewer flip back to the text to find out what “Alternative 1” is, or what a particular abbreviation stands for. Make table and figure captions self-explanatory. In general, the table or figure caption should tell the reader what the overall point of the figure/table is. For example, do not say simply: “Number of Diabetics vs. Time.” Rather say: “Number of Diabetics vs. Time. This shows that the number of diabetics has increased exponentially in the past 10 years.” Number all pages. The reports must be typed double-spaced, with 1-inch margins on both sides, a 1-inch margin on top and bottom of the page. Use 11-point type.

**Writing Constructs to Avoid:** Please avoid the following in your writing:

Do not use first person. Passive voice is fine.

Never use the phrase “due to the fact that.” This is wordy and can be replaced by the more succinct “because.”

Do not use words like “quite” and “very.” These are always superfluous and usually do not add the intensification desired. Compare the following two sentences: “Arthritis is very painful.” vs “Arthritis is painful.” Interestingly, the use of the word “very” makes the sentence sound more subjective and less authoritative, tending to reduce its impact rather than intensify it.

Do not indicate any signs of doubt.

Do not express opinion. Nobody will care what you think. If you say, “I believe that this project will lead to improved diagnostic procedures for hepatitis,” it sounds less authoritative than, “The proposed project will lead to improved procedures for hepatitis.”

And you certainly do not want to say, “I believe that the incidence of tuberculosis has increased over the last 5 years.” You want to say, “The incidence of tuberculosis has increased from 4000 per year to 8000 per year from 1997 to 2002 (Nussbaum et al., 2002).

Do not use statements like, “The American Heritage Dictionary defines bursitis as inflammation of a bursa, especially in the shoulder, elbow or knee joints.” The reader will infer that you did not know what bursitis was when you first started this project, so you looked it up in the dictionary. This approach may be okay for someone who is writing for a newspaper, but is inappropriate for someone who is working in the field. Consider how much more convincing it is to simply say, “Bursitis is an inflammation of a bursa (Boyer et al., 1983).” Be aware also that the dictionary may not be the best place to go for a clinical definition of a disease.

See the “Checklist for Writing” for more information about writing clearly and concisely.