

Independent Specific Aim Requirement

Biochemistry Graduate Program

I. Introduction and rationale

Scientists working in academia, industry, and many other settings must develop research questions and devise experiments to address those questions. Most graduate programs have students develop a research proposal as part of the degree requirements. PhD students in the Biochemistry Graduate Program at UMD are required to develop one specific aim that is tied to their own dissertation research project but that is conceived by the student **independently of and without input from the dissertation advisor**.

You must develop an **Independent Specific Aim (IA)** during your 4th-year and present it to your dissertation committee in written form and orally during your 4th-year meeting with your committee.

The IA assignment replaces the former Independent Research Proposal (IP) requirement.

II. Description of the assignment

Students must develop one research Specific Aim that could be pursued as part of their own research project. This aim must be different from specific projects that you have discussed in detail previously with your advisor. It may not be the project of another member of your research group nor may it be an aim taken from a grant proposal written by your dissertation advisor (funded or otherwise).

You are not actually expected to pursue this aim experimentally as part of your research (although you may do so if you, your advisor, and your committee believe it would be worthwhile). The experiments and project that you propose must be feasible. However, they need not be the type of work nor need they make use of experimental methods with which you have hands-on experience or that are in use in your lab. Thus the aim may address an issue that is peripheral to or very different from the focus of your own research. You are encouraged to think about new directions that the research could take and to learn about new experimental methods as part of this assignment.

You must ask a member of your dissertation committee to serve as an **Independent Aim Advisor** to assist you in fulfilling this assignment. You should meet with your IA advisor regularly to discuss ideas for research questions and for methods that could be applied to address that question. You must give the IA advisor at least one draft of your aim at least three weeks before a scheduled meeting with your committee. The IA advisor will communicate with your research advisor to verify the independence of the aim.

III. Format

The aim should be a single, focused question that could be addressed in about 1-2 years of experimentation. You must describe the experiments that could be used to address the aim. You will be expected to have read about the methods that will be applied, including their underlying physical or chemical basis, the type of data that are obtained, and the specific data that might be obtained in your specific application. You should also include necessary controls and consider alternate or back-up approaches to address the question if your proposed method does not give interpretable results. You need not give lengthy descriptions of how genes will be

cloned, subcloned, or otherwise manipulated, of protein purification procedures, how an antibody will be prepared, etc.

You must describe the aim in a short written paper about three pages in length. The paper should be organized in the major sections required for an NIH grant application:

1. Specific Aim(s) (1 page or less)
2. Research Strategy (*approx.* 2 pages)
 - i) Significance
 - ii) Innovation
 - iii) Approach

These sections are described in greater detail below, under **V. Specific instructions** and **VII. Further information and guidelines**. See also the instructions for NIH research grant applications that can be downloaded from:

<https://grants.nih.gov/grants/how-to-apply-application-guide.html>

The paper should be formatted as required for an NIH proposal:

- Single-spaced; no more than 6 lines per vertical inch;
- 11 point font, no more than 15 characters per inch. Recommended fonts are Arial, Georgia, Helvetica, or Palatino Linotype.
- One inch margins.
- References do not count in the total page count.

You must give the final version of the 3-page written document to your committee at least 4 working days before the date of the committee meeting. You may send an electronic copy as an email attachment; committee members may also request a printed copy.

IV. Evaluation

You will present this independent aim to your dissertation committee during your 4th-year progress report meeting. This meeting can occur anytime in the 4th year, but most likely in the winter or spring. The meeting date need not be tied to your 4th-year seminar date.

The committee will critique the independent aim for its significance, originality, and feasibility. They will question you to probe your understanding of the aim and the methods to be used. Thus you must devote some time to studying the methods and thinking prospectively about what the data might look like, pitfalls in the experiment, etc. You may be asked by the committee to rewrite part or all of the proposed aim to address any deficiencies in the written document or that become evident during the meeting.

The primary purpose of the 4th-year meeting is to review your progress and address difficulties that you may have encountered in your actual research. You will prepare a separate written document that summarizes your progress, plans, and obstacles that you may have encountered in your research. The committee should provide advice, assistance, and support to you regarding these issues.

V. Specific instructions

The following has been copied directly from the “Research Instructions for NIH and Other PHS Agencies” downloaded from the NIH web-site at:

<https://grants.nih.gov/grants/how-to-apply-application-guide.html>

These instructions are for a complete NIH grant application which normally includes 2-4 specific aims. Not all points will be pertinent for every student's aim. Nonetheless you should use these instructions as the starting point for writing your paper.

Specific Aims

- State concisely the goals of the proposed research and summarize the expected outcome(s), including the impact that the results of the proposed research will have on the research field(s) involved. [Note - this is the overall goal of your research project, not your specific aim]
- List succinctly the specific objective of the research proposed (e.g., to test a stated hypothesis, create a novel design, solve a specific problem, challenge an existing paradigm or clinical practice, address a critical barrier to progress in the field, or develop new technology).” [i.e., state your specific aim]

Research Strategy

Significance

- Explain the importance of the problem or critical barrier to progress that the proposed project addresses.
- Describe the scientific premise for the proposed project, including consideration of the strengths and weaknesses of published research or preliminary data crucial to the support of your application.
- Explain how the proposed project will improve scientific knowledge, technical capability, and/or clinical practice in one or more broad fields.

Innovation

- Explain how the application challenges and seeks to shift current research or clinical practice paradigms.
- Describe any novel theoretical concepts, approaches or methodologies, instrumentation or interventions to be developed or used, and any advantage over existing methodologies, instrumentation, or interventions.
- Explain any refinements, improvements, or new applications of theoretical concepts, approaches or methodologies, instrumentation, or interventions.

Approach

- Describe the overall strategy, methodology, and analyses to be used to accomplish the specific aims of the project. Describe the experimental design and methods proposed and how they will achieve robust and unbiased results. . . . Include how the data will be collected, analyzed, and interpreted, as well as any resource sharing plans as appropriate.
- Discuss potential problems, alternative strategies, and benchmarks for success anticipated to achieve the aims.
- If the project is in the early stages of development, describe any strategy to establish feasibility, and address the management of any high risk aspects of the proposed work.

[Considerations for inclusiveness of human subjects, hazardous materials, and human embryonic stem cells follow in the NIH instructions but they have been omitted from this list.]

VI. Intellectual property statement

Students are not required to do experiments to address the research aim that they devise as part of this assignment. There has been some question in the past as to the rights that are retained by the student and by the faculty mentor for the use of the research idea and description generated by the student. The following statement comes from the Office of General Counsel of the University of Maryland.

1. The written document that you create and submit in connection with this assignment is protected as a copyrighted work. As the author of that document, you will own the copyright for that document in accordance with the University of Maryland Intellectual Property Policy.
2. The ideas that are conveyed in your document are not protected by copyright and may be protected by patent law only if the ideas as expressed qualify as patentable inventions under patent law.
3. As a result, the question and the experiments that you propose to address that question may be modified and/or implemented by others including, for example, your dissertation advisor and other graduate students, as long as their use does not infringe your copyright or patent rights. In addition, the ideas presented in your assignment may be included in grant proposal applications submitted by your advisor without your prior consent, although professional standards regarding proper attribution and citations, if applicable, shall apply. The specific text of your document may not be used in a grant proposal or other documents without appropriate citation and/or permission. Should the ideas expressed in your document or specific text from your document be referenced or quoted in a journal article or other publication, the author of the publication will be obliged to comply with appropriate guidelines and standards related to authorship and/or acknowledgment of the contributions of others.
4. You are free to engage in the research and conduct experiments presented in your document or related to your question after you complete your studies at the University without obtaining the prior permission of your dissertation advisor, although you may wish to discuss such work with your advisor as a matter of professional courtesy.
5. Should you have questions about your intellectual property rights, you may consult with the Office of Technology Commercialization (<http://www.otc.umd.edu/>), legal counsel of your own choosing, or the following resources:
 - i) University Libraries Copyright Guide: <http://lib.guides.umd.edu/copyright>.
 - ii) University of Maryland Intellectual Property Policy:
<https://president.umd.edu/administration/policies/section-iv-research/iv-320a>
 - iii) A Patent System for the 21st Century (Appendix A: A Patent Primer), National Academies Press, 2004 (<https://www.nap.edu/read/10976/chapter/10>).
 - iv) United States Patent and Trademark Office: <https://www.uspto.gov/patent>
 - v) United States Copyright Office: <https://www.copyright.gov/>

VII. Further information and guidelines

A. What is a Specific Aim?

A specific aim in a grant proposal is a statement of a scientific question or of the intention to test a specific hypothesis.

A specific aim is NOT a statement of the intention to apply an experimental method to a system of interest or simply a statement of the intention to do a specific experiment. A specific aim is also NOT proposing to prove a specific hypothesis, rather than to test that hypothesis.

A detailed discussion of how to write the specific aims of a grant proposal can be found in a file called **Specific Aims QB3.02_22_11.pdf**.¹ This document gives several examples of specific aims from grant applications as well as the examples of poorly posed specific aims given below.

The following aims are poor because they describe application of a method rather than posing a question:

“Aim A. To use targeted gene replacement to create a BRCA1^{-/-} knockout mouse.”

“Aim B. To analyze gene expression profiles using microarray analysis in normal vs. cancerous prostate cells.”

“Aim C. To overexpress several components of the telomerase enzyme in *S. cerevisiae* and measure DNA repair efficiency at telomere ends.”

The following are poorly worded because they pre-suppose the result of an experiment or aim to prove rather than to test a hypothesis.

“Aim X. Show that p53 is upregulated in a chronic inflammation mouse model.”

“Aim Y. Demonstrate that downregulation of p53 using siRNA decreases inflammation.”

“Aim Z. Characterize additional p53 binding targets due to upregulation in response to chronic inflammation.”

B. Other Sources of information and tips about grant writing

i) A short tutorial on writing specific aims, from the University of Washington, is:
[session3_WritingEffectiveSpecificAims_U_Wash.pdf](#)
 which can be found by a Google search.

ii) A brief discussion of how to write and organize the Specific Aims page of an NIH grant application can be found at:
<http://www.biosciencewriters.com/NIH-Grant-Applications-The-Anatomy-of-a-Specific-Aims-Page.aspx>

iii) The detailed instructions for how to write an NIH grant application are found at:
<https://grants.nih.gov/grants/how-to-apply-application-guide/format-and-write/write-your-application.htm>

This site has much more information than is needed for this assignment. Nonetheless it is worth checking, particularly for the “Important Writing Tips” that can be found half-way down the page.

¹Specific Aims QB3.02_22_11.pdf, by E. Whitney, California Institute for Quantitative Biosciences, can be found at:
http://www.learningace.com/doc/3059401/bf2666f7c98cab484fd0b1e2bc8972c9/specific_aims_qb3-02_22_11