

# **Comprehensive Exam Guidelines**

**Why this is needed:** Due to the variability in exam requirements and how different committees approach the exam, the graduate committee has identified that we need to standardize this comprehensive exam for all students as the bar should be as close to “similarity” for all and that students have a clear idea of what is expected of them in the written and oral parts of the exam. Some of the expectations for the exam are:

- The written part of the exam should be in the form of a large research grant such as the R01 at NIH, or Standard Research grant at NSF or USDA.
- The proposal subject should not overlap with the student’s research project. The reason for this is so that the student will have to study the literature in depth and formulated his/her own hypotheses. Examples: If a student is studying xylem tissue in corn, a suitable project would be to investigate pollen formation in corn. If a student is investigating redox enzymes in mammalian liver, than a suitable project would be synaptic function in the brain.
- The proposal can be hypothesis- or discovery-driven. The proposal should be based on the scientific method, including a testable hypothesis and the experiments that test it best. A good rule-of-thumb when writing is to repeatedly ask yourself, is this the best way to answer my hypothesis? If the answer is “no”, then the hypothesis or the experiments should be changed to fit.

## **Proposing topics**

Students should propose to their committee at least two potential topics in writing. The purpose of this is twofold. First, to get feedback on their initial thoughts before they have put a proposal’s worth of writing into them. Second, to ensure their topics of choice are suitable to the committee in terms of overlapping with their research projects.

To this end, students should propose two or more abstracts on topics of their choice. Note the description of an abstract below.

## **Guidance for Writing the Proposal**

Below is the generic format of the written grant. It is recommended that the sections comprising the Overview, Significance, and Approach not exceed 10 pages in length.

**Audience:** Proposals are written for an informed scientific audience that are not in the sub-specialty you are writing about. If you find yourself wondering what is “common knowledge” and what is not, look at a few reviews of nearby topics. If the review explains the idea you are wondering about, so should you.

**Descriptive title:** The title should highlight the main theme of the proposal and be no more than 80 characters long

**Abstract/Summary (300 words to 1 page):** An adequate summary of the proposal with a short description of the background, hypothesis, rationale, objectives/aims, and outcomes. The goal of the abstract/summary is to communicate the major ideas in the proposal.

**Overview/background (1 page):** This contains an introductory paragraph narrowing from common knowledge, through current knowledge, to the Gap in that knowledge. The second paragraph should state the long-term goal, hypothesis of the proposal, and rationale. Following this is the objectives or aims and perceived outcomes. The student should write out 3 clear independent objectives/aims that support the hypothesis, and the outcomes of each should be briefly described.

**Significance/background (1-2 pages):** This section describes the significance of the proposed work in the contextual framework of what has already been published. Think of it as an effort to show the described plan of work will address an important gap in understanding.

**Central Figure:** In either the overview or significance sections, a figure describing the overall approach of the proposal should be included. This figure should be self-made, and illustrate as broadly yet succinctly as possible the goals of the work. Good graphical abstracts are excellent examples of useful figures.

Preliminary Data: This is where the writer includes preliminary knowledge that is essential for the “plan of work/approach” section. The preliminary data will be key figures taken from the literature and cited as such. Think of it as an effort to make the described plan of work seem feasible. E.g., Objective/Aim 1 takes advantage of a mutant/ecotype/variant of the typical wildtype. A figure in the preliminary data would show this mutant/ecotype/variant is available and its phenotype is relevant in the context of the proposed plan of work.

Plan of Work/Approach: This section should outline a logical experimental plan for each objective/aim. The space devoted for each aim should be around 2 pages long. Each objective/aim may contain sub-aims and each objective/aim should contain sections for “expected outcomes” and “alternative approaches”. The brief “Expected Outcomes” subsection should clearly indicate new knowledge expected after the proposed work. The brief “Alternative Approaches” subsection should indicate any major pitfalls that could occur in the plan of work and indicate why they are unexpected (with references) or alternative strategies that will be pursued if they fail. At least one objective/aim must be hypothesis driven, predicting and testing an outcome. “Discovery” based objectives/aims (e.g., multiple-omics descriptions of a phenotype), if included, should include a rational strategy to integrate resulting data to generate useful future hypotheses, and should not comprise the entire proposal.

A note on redundancy: Proposals are by their nature more redundant than journal articles. The aims/objectives and any associated hypotheses can and should be stated identically multiple times throughout your proposal (Abstract, Overview, and Plan of Work/Approach). The goal of the redundancy is to cue your reader to quickly and easily recall your complex experimental plan by a quick skim of the abstract and overview during a review panel. Similarly, the importance of your proposed work is written in approximately three places (abstract, Overview, Significance/background). Two of these are brief, while the final section is as complete a review of literature as necessary. Outcomes of the proposed work will be stated in the Overview and each aim/objective in the Plan of Work. Again, these are repetitions by design to cue your reader during review. Note that neither the importance of your work nor the outcomes of your work should use the precise wording from other sections, while this is encouraged for the titles of the aims/objectives and any associated hypotheses.

References: The references should be in a standard professional format containing at least authors, title, journal, year, DOI or vol(issue)pages.

Other ancillary documents that the committee may agree to be a useful portion of the exam depending on the student’s future direction:

- Broader Impacts (1 page limit, NSF only)
- Animal form (if animal use is proposed)
- Biosketch of the student (2 page limit)
- Budget and budget justification: OPD has a generic budget spreadsheet and this may be a good place where students will finally understand direct and indirect costs, F&A, etc.
- Timeline of proposed work

OPD is the office of proposal development found at <https://research.unl.edu/proposaldevelopment/home/>

# Standard NSF Proposal Outline

**Note:** This outline addresses key development components of a standard NSF application; however, it does not address all elements required to complete the application or budget. Complete instructions are available in the solicitation and the [NSF Proposal and Award Policies and Procedures Guide](#).

## Formatting Instructions:

- Use one of the following typefaces: Arial, Courier New, or Palatino Linotype at a font size of 10 points or larger; Times New Roman at a font size of 11 points or larger; or Computer Modern family of fonts at a font size of 11 points or larger.
- Other fonts not specified above, such as Cambria Math, may be used for mathematical formulas, equations, or when inserting Greek letters or special characters.
- A font size of less than 10 points may be used for mathematical formulas or equations, figures, table or diagram captions and when using a Symbol font to insert Greek letters or special characters. The text must still be readable.
- Margins must be at least one inch in all directions.
- Line spacing must not exceed six lines of text per vertical inch.
- Individually paginate each document of the proposal.

## 1. Project Summary (limited to 1 page)

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The *Project Summary* should be informative to other persons working in the same or related fields and, insofar as possible, understandable to a broad audience within the scientific domain. It should not be an abstract of the proposal. The summary must include three separate sections, each of which is input into a text box in FastLane:

- **Overview:** Describe the activity that would result if the proposal were funded and state the objectives and methods to be employed.
- **Intellectual Merit:** Describe the potential of the proposed activity to advance knowledge within its own field or across different fields, including the qualifications of the team to conduct the project and the extent to which the proposed activities suggest and explore creative, original, or potentially transformative concepts.
- **Broader Impacts:** Describe the potential of the proposed activity to benefit society and contribute to the achievement of specific, desired societal outcomes.

## 2. Project Description (limited to 15 pages)

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The *Project Description* should provide a clear statement of the work to be undertaken. URLs must not be used. Should this project involve collaboration with other institutions/organizations, describe the roles to be played by the other entities, specify the managerial arrangements, and explain the advantages of the multi-organizational effort. (Note: With the exception of the “Results from Prior NSF Support” subsection, page limitations for each subsection in the *Project Description* are suggestions only; proposals that use the maximum number of pages in each subsection will not be in compliance with the overall 15-page limitation.)

### Overview, Goal, and Objectives (suggested length: 1 to 1.5 pages)

- Succinctly state (2-3 paragraphs) the problem or opportunity your proposal will address. Briefly address how your proposed research will help synthesize, build, and/or expand research foundations in the areas identified as priorities in the solicitation.
- Clearly elucidate the long-term goal of your research, the overall goal of the proposed project, and the specific objectives of the work proposed.

### Background and Significance (suggested length: 3.5 to 5 pages)

- Briefly sketch the background leading to the application, critically evaluate existing knowledge, and identify the gaps that the project is intended to fill. Discuss how this project will generate foundational research that will advance the

field in general or address significant challenges. Also describe the contributions the project will make to synthesizing, expanding, or building the base of knowledge and evidence needed in the field, and to the development of theory and methodology.

- Summarize any prior work relevant to the proposed project as well as relevant work in progress by the PI under other support.

### **Research Plan (suggested length: 7 to 9 pages)**

- Describe the work necessary to meet the objectives set forth in the first section.
- Include clear statements of the research activities to be undertaken, including experimental methods and procedures.
- Include any plans for collaboration among researchers in related disciplines.
- Include evaluation criteria, as well as a timeline for the completion of project activities and key milestones.
- If proposing the use of vertebrate animals, sufficient information must be provided to enable reviewers to evaluate the rationale for involving animals; choice of species and number of animals to be used; description of the proposed use of the animals; exposure of animals to discomfort, pain, or injury; and description of any euthanasia methods to be used.
- For proposals that include funding to an International Branch Campus of a U.S. institution of higher education or to a foreign organization (including through use of a subaward or consultant arrangement), provide a justification for why the project activities cannot be performed at the U.S. campus.

### **Broader Impacts (suggested length: ½ to 1 page)**

- The *Project Description* must contain, as a separate section within the narrative, a section labeled “Broader Impacts”.
- Discuss the broader impacts of the proposed activities, which may be accomplished through the research itself, activities directly related to the research, or activities supported by, but complementary to, the project.

### **Intellectual Merit (required for proposals submitted or due before June 1, 2020; optional for proposals submitted or due on or after June 1, 2020; suggested length: ½ page)**

- The intellectual merit of a project encompasses its potential to advance knowledge within its own field or across different fields.
- Discuss the qualifications of the team to conduct the project.
- Explain the extent to which the proposed activities suggest and explore creative, original, or potentially transformative concepts.

## **3. References Cited (no page limit)**

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This section should contain a list of bibliographic citations relevant to the proposal. While there is no page limit, please note that this section must contain bibliographic citations only and cannot include any parenthetical information. Note that:

- Each reference must include the names of all authors (in the same sequence in which they appear in the publication), the article and journal title, book title, volume number, page numbers, and year of publication.
- The website address should be identified if the document is available electronically.
- Proposers must conform to accepted scholarly practices in citing source materials relied upon in the proposal.

## **4. Biographical Sketches (limited to 2 pages each)**

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Provide a biographical sketch for each person identified as senior personnel. An NSF-approved biographical sketch format must be used. Instructions and templates for creating an NSF-approved biographical sketch can be found [here](#).

## **5. Budget and Budget Justification (budget justification limited to 5 pages)**

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Elijah Luebbe in the Office of Sponsored Programs can provide assistance with the *Budget* and *Budget Justification* (eluebbe2@unl.edu, 402-472-1871).

## Proposal Component Checklist and Narrative Instructions

# National Institutes of Health

Research and Other (“R” Series) Instructions (e.g., R01, R03, R21)

*This document provides a checklist of proposal components for standard NIH Research Grant (R series) proposals (e.g., R01, R03, or R21) on the first and second page, followed by detailed instructions for completing the narrative attachments. While this document provides summarized instructions, complete instructions can be found by reviewing the relevant Funding Opportunity Announcement (FOA) and the SF424 (R&R) Research (R) Instructions – Form Version F Series.*

***Note:** Page limits provided throughout are for standard R01, R03, and R21 proposals but may vary for other NIH mechanisms and specific Program Announcements (PAs) or Requests for Application (RFAs).*

### **Formatting Instructions for Narrative Attachments**

- Recommend using Arial font. A font size of 11 points or larger must be used. The font must be no more than 15 characters per linear inch (including characters and spaces) and must be no more than six lines per vertical inch.
- Smaller text in figures, graphs, diagrams, and charts is acceptable as long as it is legible.
- Use English and avoid jargon; spell out acronyms the first time it is used in each application section/attachment and note the appropriate abbreviation in parentheses. The abbreviation may be used in the section/attachment thereafter.
- Use at least one-half inch margins (top, bottom, left, and right) for all pages. No applicant-supplied information should appear in the margins, headers, or footers.
- Strongly encouraged to use only a standard, single-column format for the text.
- Hyperlinks and URLs are only allowed when specifically noted in the FOA and form field instructions (e.g., biographical sketches or publication lists). It is highly unusual for a FOA to allow links in the Specific Aims, Research Strategy, and other page-limited attachments. Hyperlinks and URLs may not be used to provide information necessary to application review. When allowed, you must hyperlink the actual URL text so it appears on the page rather than hiding the URL behind a specific word or phrase.
- For additional information on standard formatting requirements, see the NIH [Format Attachments](#) page.

### **Specific Aims (limited to one page)**

- 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 exert on the research field(s) involved.
- List succinctly the specific aims of the research proposed.

### **Research Strategy (limited to 12 pages)**

- Organize the Research Strategy in the order specified below.
- Start each section with the appropriate section heading – Significance, Innovation, and Approach.
- Cite published experimental details in the Research Strategy and provide the full reference in the Bibliography and References Cited document.

#### **1. Significance**

- Explain the importance of the problem or critical barrier to progress that the proposed project addresses.
- Describe the strengths and weaknesses in the rigor of the prior research (both published and unpublished) that serves as the key support for the proposed project.

- Explain how the proposed project will improve scientific knowledge, technical capability, and/or clinical practice in one or more broad fields.
- Describe how the concepts, methods, technologies, treatments, services, or preventative interventions that drive this field will be changed if the proposed aims are achieved.

## **2. Innovation**

- Explain how project 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.

## **3. Approach**

- Describe the overall strategy, methodology, and analyses to be used to accomplish the specific aims.
- Describe plans to address weaknesses in the rigor of the prior research that serves as the key support for the proposed 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, unless addressed separately in the Resource Sharing Plan document below.
- Discuss potential problems, alternative strategies, and benchmarks for success anticipated to achieve the aims.
- You also may wish to include a discussion of future directions for your research, as well as a project timeline, in this section.
- 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.
- For trials that randomize groups or deliver interventions to groups, describe how your methods for analysis and sample size are appropriate for your plans for participant assignment and intervention delivery. These methods can include a group- or cluster-randomized trial or an individually randomized group-treatment trial.
- For studies in vertebrate animals and humans, explain how relevant biological variables, such as sex, are factored into research designs and analyses. For example, strong justification from the scientific literature, preliminary data, or other relevant considerations must be provided for applications proposing to study only one sex.
- Point out any procedures, situations, or materials that may be hazardous to personnel and precautions to be exercised. A full discussion on the use of select agents should appear in the Select Agent Research document below.
- If research on Human Embryonic Stem Cells (hESCs) is proposed but an approved cell line from the NIH hESC Registry cannot be chosen, provide a strong justification for why an appropriate cell line cannot be chosen from the registry at this time.
- **Preliminary Data:** For new applications, include information on preliminary studies, data, and/or experience pertinent to this application. Except for Exploratory/Developmental Grants (R21/R33), Small Research Grants (R03), and Academic Research Enhancement Award Grants (R15), preliminary data can be an essential part of a research grant application and help to establish the likelihood of success of the proposed project. Early Stage Investigators should include preliminary data.

## **Vertebrate Animals**

- **Complete this section if vertebrate animals will be used in your project.**
- **Address each of the following criteria:**
  - **Description of Procedures:** Provide a concise description of the proposed procedures that involve live vertebrate animals in the work outlined in the Research Strategy. Include sufficient detail to allow evaluation of the procedures. Identify the species, strains, ages, sex, and total numbers of animals by species to be used. If dogs or cats are proposed, provide the source of the animals.
  - **Justifications:** Provide justification that the species are appropriate for the proposed research. Explain why the research goals cannot be accomplished using an alternative model (e.g., computational, human, invertebrate, in vitro).
  - **Minimization of Pain and Distress:** Describe the interventions, including analgesia, anesthesia, sedation, palliative care, and humane endpoints, that will be used to minimize discomfort, distress, pain, and injury.

- Identify all project/performance or collaborating site(s) and describe the proposed research activities with vertebrate animals that will be conducted at those sites.
- If applicable, explain when and how animals are expected to be used if plans for the use of animals have not been finalized.

**Biographical Sketch** (limited to five pages per biographical sketch)

- Provide a biographical sketch for the PD/PI(s), each senior/key person, and each other significant contributor. In light of federal agencies' heightened sensitivity to foreign influence on the United States, make sure the bio lists all affiliations/appointments with any outside entities (including international entities), even if unpaid. A National Institutes of Health [biographical sketch template](#) is required.

**Bibliography and References Cited**

- Should include any references cited in the PHS 398 Research Plan Form and in the PHS Human Subjects and Clinical Trials Information form.
- References should be limited to relevant and current literature.
- When citing articles that fall under the Public Access Policy, were authored or co-authored by the applicant, and arose from NIH support, provide the NIH Manuscript Submission reference number (e.g., NIHMS97531) or the PubMed Central (PMC) reference number (e.g., PMCID234567) for each article. If the PMCID is not yet available because the Journal submits articles directly to PMC on behalf of their authors, indicate "PMC Journal – In Process." NIH maintains a list of such journals.