Preparation of the Research Proposal Manuscript and Presentation

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Overview

1. Defining the Research Proposal
2. Formatting the written proposal
3. Highlighting key features of the proposal presentation and expectations
4. Research Proposal documentation

Overview

1. **Defining the Research Proposal**
2. Formatting the written proposal
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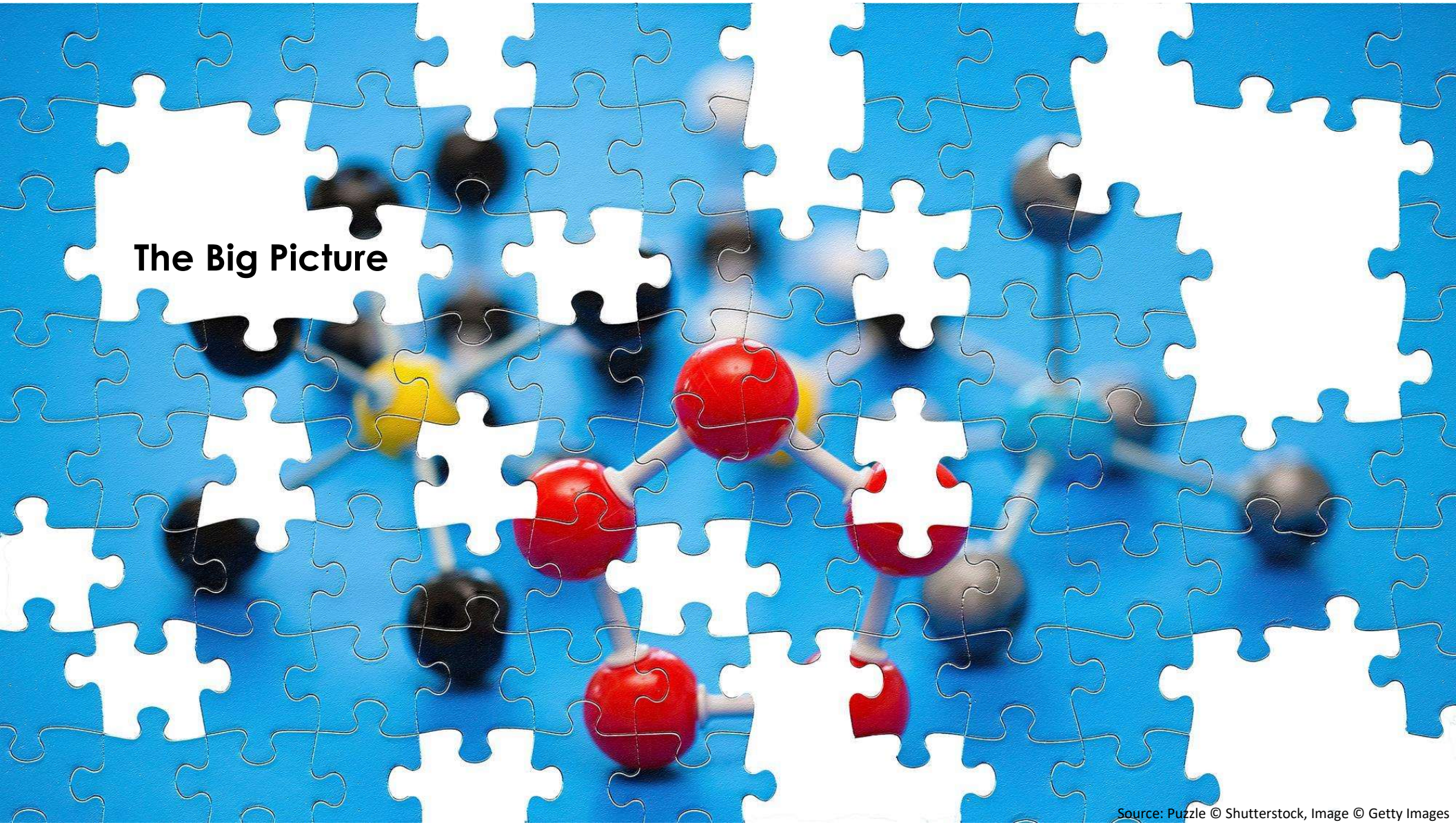
4. Research Proposal documentation

What is the Research Proposal?

Both the thesis research proposal and original research proposal are an organized and innovatice workplan to feasibly address an important scientific problem by applying fundamental chemical principles and using appropriate instrumentation and techniques. The expected duration of the project is a minimum of two years allotting for additional time where necessary for scientific communication of the project accomplishments.



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What is the Research Proposal?

In this proposal you will:

- Present and contextualize a scientific problem
  - Explain why this is significant.
- Define your contribution toward tackling the scientific problem
  - Explain what you intend to do.
  - How does it complement or improve on "gold standard" approaches?
- Establish 3 specific aims
- Determine short-term and long-term deliverables
  - Intellectual merit and Broad Impact
  - Be realistic; feasible deadlines

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Research Proposal Format

- **National Institutes of Health (NIH) guidelines**
  - https://grants.nih.gov/grants/how-to-apply-application-guide/forms-f/research-forms-f.pdf
  - https://grants.nih.gov/grants/guide/pa-files/PA-20-185.html
- **National Science Foundation (NSF) guidelines**
  - https://www.nsf.gov/pubs/policydocs/pappg22_1/nsf22_1.pdf

Research Proposal Format

1. Title Page (1 page)
2. Table of Contents (1 page)
3. Project Summary/Abstract (0.5 page)
4. Specific Aims (1 page)
5. Research Strategy (12 pages)
6. Timeline (1 page)
7. References/Literature Cited (No page limit)
8. Facilities, Equipment, and Other Resources (No page limit)

- Times New Roman, 12 pt font, single space
- Number your pages

Table of Contents

- **Tabulate the sections of your proposal and the corresponding page numbers**

Section	Page(s)
Project Summary	1
Specific Aims	2
Research Strategy	3-14
Timeline	15
References	16-17
Facilities, Equipment, and Other Resources	18-20

Project Summary/Abstract

A concise description of the proposed work.

- State the proposal's broad, long-term objectives (define the scientific problem being addressed) and specific aims.
- Describe the research design and methods for achieving the specific aims.

Specific Aims

- In a short one to two paragraphs, provide a brief big picture overview of your project. Briefly state the goals of the proposed research (your contribution/innovation) and summarize the expected outcome(s) including the impact that the results of the proposed research will have on the research field(s) involved.

- List concisely the specific objectives of the research proposed

Specific Aims Format

- Define three specific aims
  - Title of the aim
  - Hypothesis (if relevant)
  - Brief description of the strategy to complete the aim
- The aims should align with your time to graduation (~3 to 4 years)
  - One aim/year

Research Strategy

Formally present the scientific problem that will be addressed and describe your innovative contribution and define it with respect to complementing or improving upon current approaches or even developing something for the first time ever.

1. Background and Significance
2. Innovation
3. Approach
   - Introduce each specific aim
     - Describe experimental plan (Methodology, analysis)
     - Present preliminary data
     - Discuss expected outcomes
     - Establish benchmarks for success and alternative plans
4. Intellectual Merit
5. Broader Impacts

1. Background and significance

- Explain the background and importance of the scientific problem.
- Present current approaches addressing the problem and any limitations.
- Explain how the proposed project will address the scientific problem, improve scientific knowledge, and any relevant technical capability.

2. Innovation

- Describe any novel theoretical concepts, approaches/ methodologies, and instrumentation to be developed or used, and any advantage over existing ones.

- Explain any refinements, improvements, or new applications of theoretical concepts, approaches/methodologies, and instrumentation.

3. Approach

In a few paragraphs, begin the approach section by:

- Describing the overall strategy, methodology, and analyses to accomplish the specific aims of the project while addressing how your work will address the limitations or lack thereof of current approaches.

3. Approach

Then present each specific aim:

- Reintroduce the title of your specific aim.
- In one or two paragraphs, describe the overall strategy (experiments and critical analysis) for the aim.
- Present the formal experimental plan
  - Define key experiments that will be done.
  - Describe any relevant positive and negative controls
  - Describe the instrumentation and techniques that will be used and how they will be specifically implemented.

3. Approach

Then present each specific aim (continuation):

- Present the formal analysis plan
  - Explain what programs or software will be used to analyze your data.
  - Explain how you will analyze your data to determine whether an experiment was performed successfully.
  - Avoid being overly general:
    "I am going to do NMR to characterize my compound."

3. Approach

Then present each specific aim (continuation):

- Present the preliminary results.
  - Include the raw/processed data and analysis and any relevant conclusion.
- Define expected outcomes where no preliminary results exist.
- Discuss benchmarks for success and alternative strategies.
  - Not every experiment has to be successful in order for you to reach a critical mass of data to define the success for completing your specific aim.
  - Because not all experiments will be successful, what alternative strategies and workplans can you use to achieve the necessary endgoal.

3. Approach

Use the same strategy for the subsequent aims.

4. Intellectual Merit

The statement on intellectual merit should describe the potential of the proposed project to advance knowledge.

- Describe what new concepts or content is being developed that can be applied for scientific education.

- Describe how you plan to engage in scientific communication using the output and outcome of your work.
  - Research conferences
  - Peer-reviewed publication (Primary research, reviews, etc.)
  - Academic outreach

5. Broader Impacts

The statement on broader impacts should describe the potential of the proposed project to benefit society and contribute to the achievement of specific, desired societal outcomes.

- Your research is designed to be of value to the community at large. Consider who will be directly benefited by it.

- How can this information be communicated to the population of interest?

Timeline

Prepare a feasible timeline with project deliverables.

Activity	Year 1				Year 2				Year 3				Years 4			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Specific Aim 1																
Experiments																
Data Analysis																
Manuscript																
Specific Aim 2																
Experiments																
Data Analysis																
Manuscript																
Specific Aim 3																
Experiments																
Data Analysis																
Manuscript																
Conference Presentation																
Original Proposal Writing and Presentation																
Thesis Writing																
Thesis Defense																

References

- Include a combination of relevant older and current literature that help to contextualize the scientific problem and highlights its importance.

- Include references that support the feasibility of your proposed specific aims and that strengthen your innovation.

Facilities, Equipment, and Other Resources

- It is vital to the success of your project and the efficiency of your time and effort devoted to it to be aware of the instruments, tools, and techniques available to you in your laboratory and also in the laboratories of others and in instrumentation centers at your availability.

- Wherever there is a limitation in the facilities, contact collaborators who are willing to help you with your project.
  - Networking is KEY!

Equipment

University of Puerto Rico (Río Piedras Campus)

Tinoco Lab

- Spectroscopic Instrumentation
  - Thermostated Cary 300 UV-Vis spectrophotometer including dip probe, stopped-flow, and melting curve accessories
  - NanoDrop 2000
  - Tecan Infinite M200 PRO for fluorimetric and absorbance plate reading
- Resources for Chemical Synthesis and Biochemical Studies
  - Pharmacia Fast Protein Chromatography system
  - Agilent Technologies HPLC
  - Bench top centrifuges (eppendorf 5810 and eppendorf5415D)
  - Ultracentrifuges
  - Nikon microscope and camera for tissue culture work with some fluorescence capability
  - Class II tissue culture hoods and incubators for mammalian cells
  - Cell culture room for bacterial work
  - Autoclaves (One for biological work, one for biological waste)
  - -200 °C liquid nitrogen storage container for cell line storage
  - Standard molecular biology/biochemistry equipment including gel boxes and power supplies to run protein and DNA gels and Western Blots
  - Incubator-shakers
  - -80, -20, 4 ºC refrigerators
  - Cell lysis and tissue dismembrator equipment (a sonicator)
  - Fume hoods and all necessary equipment for chemical synthesis (rotovaps, a Schlenck for experiments performed in the absence of air)
  - Microwave based peptide synthesizer (CEM Liberty Blue)
  - Microwave based cleavage system (CEM)
  - SUNTEST CPS+ Atlas instrument to UV activate molecules

Chemistry Departmental Instruments

- ThermoNicolet FT-IR spectrometers models 6000 and 740 (Laboratory of Dr. Kai Griebenow)
- PCR thermocyler (Laboratory of Dr. Kai Griebenow)
- Lyophilizer
- Bruker 500 MHz and 300 MHz NMR instrument
- Agilent ESI-TOF equipped with a 1200 series LC and autosampler
- Waters Micromass quadrupole time of flight mass spectrometer equipped with a LC, MS/MS capability, and autosampler (Operateded by the Materials Characterization Center)
- Perkin Elmer ICP-MS (Laboratory of Dr. Liz Diaz)
- Perkin Elmer ICP-OES (Laboratory of Dr. Liz Diaz)

Facundo Buesto NIH-RISE Instrumentation Facilities

- Analytik Jena UVP ChemStudio Plus
- Eppendorf Centrifuges
- Shimadzu RF-6000 Spectro Fluorophotometer
- Shimadzu UV-1900
- Invitrogen Countess II Cell counter
- Biorad Power Pac Basic
- Yamato Rotovap
- GE Äkta Pure FPLC with a fraction collector
- Agilent GC MS

Figure 1. Laboratory space of Dr. Tinoco.

Additional Factors to Consider

1. Visuals
2. Language

Visuals

Chemistry is a very visual field and it is important to incorporate key images that help the reader to have a clear view of the bigger picture of the proposal and of the specific aims.

- Whenever possible, make your own images.
  - Chemdraw
  - Biorender
- Make sure to include high resolution images.
- When including molecular structure, attention to bond lengths and angles is of utmost importance.

Visuals

- Depending on the scale of the image, make your figure half page width (3.5 in.) or full page width (7 in.).

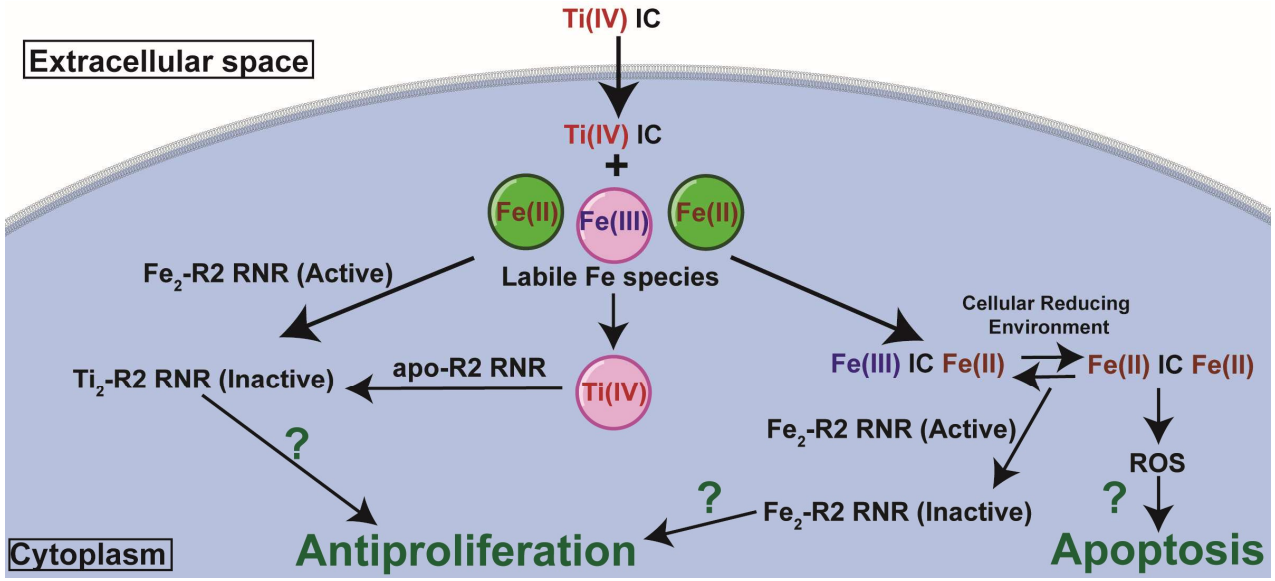
Half page width

Full page width

  - Presize your images to avoid blurriness
  - Use Arial font, 9 point for text within the figure
  - Left align half page width images as reading in English or Spanish is from left to right

Visuals

- Consider including strategy and workflow images.



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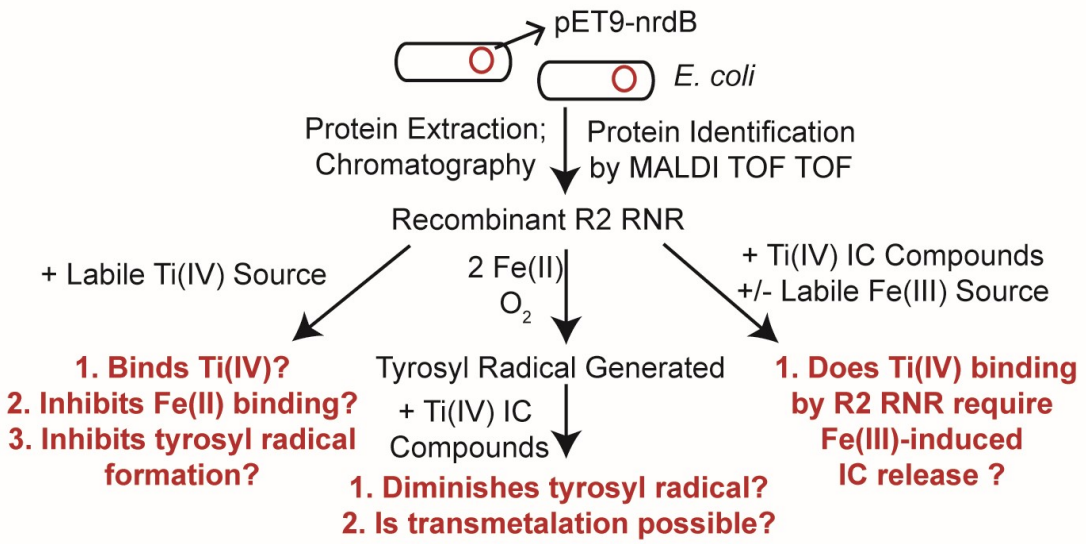

Language

Given that you are writing your research proposal to be evaluated by your Chemistry thesis committee, it is crucial that you use formal Chemistry terminology. That said,

- Use simple language to describe your work.
  - Pretentious vocabulary can make the proposal overly convoluted and hard to understand.
- Minimize overly field specific jargon
  - Not all of your thesis committee will be experts in your field
- Define all abbreviations

Beginning the Formal Writing Process

- Take thorough notes of everything that you read and learn
- Prepare an annotated bibliography of relevant articles
- Start writing by following the examples of your role models until you develop your own style

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Research Proposal Presentation Format

The research proposal presentation is both a presentation and defense of the written manuscript. As such,

- Format the presentation in a manner that parallels the research strategy of your proposal manuscript.
  - Prepare the same visuals for the manuscript and presentation

- Be ready to answer questions that go more in depth with your approach.
  - You will be expected to answer fundamental chemistry questions.
  - Prepare extra slides anticipating questions.
  - Bring chalk/erasable markers with you if presenting in person.
  - Have access to a "whiteboard" like platform if presenting virtually.

Research Proposal Presentation Format

Prepare a 30-minute PowerPoint presentation

1. Background and Significance
2. Innovation and briefly introduce all of your specific aims

(**5 – 10 minutes**)

3. Approach (**20 minutes**)
   - Discuss each specific aim
   - ➢ Describe experimental plan (Methodology, analysis)
   - ➢ Briefly discuss relevant parts of your facilities, equipment, and other resources
   - ➢ Present preliminary data
   - ➢ Discuss expected outcomes
   - ➢ Establish benchmarks for success and alternative plans

4. Intellectual Merit
5. Broader Impacts
6. Timeline

(**Be brief**)

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Research Proposal Documentation

1. Request to present the research proposal

- The request to present must be agreed upon by all thesis committee members.
- The student must inform the coordinator of the CGP about the intent to present the research proposal to receive evaluation documents.
- The student must submit the completed proposal manuscript to the thesis committee members 14 days before the day of the presentation.

Research Proposal Documentation

2. Manuscript and Presentation Evaluation forms

- Must be completed by all committee members and returned to the Chair of the committee.
- The Chair must submit the evaluation forms to the Coordinator of the CGP.

3. Manuscript and Presentation Certification form

- The Thesis Committee Chair (AKA the thesis advisor) is in charge of formally recording the feedback of the committee for any requested revisions.
- Must be signed by all committee members once the final manuscript is approved.
- The chair must submit the form and final approved draft to the Coordinator of the CGP.
- The coordinator will sign the certification form.

Words of Wisdom

Be open to constructive criticism and be mindful about how to effectively convey the story of your proposal.