Stony Brook University

Department of Neurobiology and Behavior
Master of Science Program in Neuroscience

Handbook/ Program Guidelines and Requirements Updated Summer 2026

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CHAPTER 1: PROGRAM OVERVIEW

INTRODUCTION

The MS Program in Neuroscience at Stony Brook University prepares students to conduct, analyze and communicate neuroscience research. Students will be exposed to advanced neuroscience research techniques, approaches and theory through coursework and mentored lab research, culminating with the MS degree in Biomedical Sciences – Neuroscience track.

This handbook serves to provide an overview of the program for new students and summarizes degree requirements established by the Program and the Graduate School. Follow links to see full details of Graduate School policies, explore SBU resources, and other relevant information.

ADVISING / MENTORSHIP

Students' primary advisor at the start of the program will be the Director of the Program. The Director will communicate with each incoming student prior to the initial registration for the purposes of planning specific course requirements and deciding in which laboratory to complete their research practicum. The Director will meet with students during each semester to monitor progress and plan remaining curriculum.

MS Students will learn about lab research requirements in their first course, NEU 501: Introduction to Neuroscience Research, and are expected to find a faculty lab to work in by the end of their first full semester (generally the end of the Fall semester). Students are advised not to reach out to faculty for potential lab placements prior to this course.

There are over 50 training faculty involved in the MS Program that together offer a broad choice of advisors and research topics from which to choose. About half have primary appointments in the Department of Neurobiology and Behavior. Others have primary appointments in university departments of Biochemistry, Medicine, Neurology, Pharmacology, Physiology and Biophysics, Psychology, Psychiatry, and others or in off-campus departments at Brookhaven National Laboratory and Cold Spring Harbor Laboratories. Broadly, faculty research interests include Biophysics and Cellular Neurobiology, Molecular Neurobiology, Integrative and Behavioral Neurobiology,
and Computational/Theoretical Neuroscience.

Once labs are chosen, students will notify both the MS Program Director and the Program Coordinator via email who their advisor/mentor will be for the remainder of the program. The Program Director will remain an advisor for course and degree completion requirements until graduation, however thesis work will be conducted in conjunction with the mentoring lab.

COURSE OF STUDY / DEGREE REQUIREMENTS

Flexibility exists to suit individual student needs and career ambitions. Core concepts and skills are taught through a series of required courses, with the remaining coursework consisting of advanced electives and special topics courses selected in consultation with the student's advisors. A total of at least 30 graduate credits with a cumulative GPA of 3.0 or greater are required for the MS degree. Of this, at least 8 credits must be earned in four Core Areas: Cellular and Molecular Neuroscience; Systems Neuroscience; Computational Neuroscience; Neuroanatomy. Students must also complete 4 credits in seminar courses designed to enhance reading, writing and presentation skills.

Course	Credits	Term	Area
NEU 521: Introduction to Cellular Neuroscience	3	Fall	Cellular & Molecular
NEU 522: Introduction to Molecular Neuroscience	3	Fall	Cellular & Molecular
NEU 531: Sensory and Motor Systems	2	Spring	Systems
NEU 532: Neural Plasticity, Learning and Memory	2	Spring	Systems
NEU 547: Introduction to Neural Computation	3	Fall	Computational
BNB 567: Statistics and Data Analysis I	2	Fall	Computational
NEU 536: Intro to Computational Neuroscience	2-3	Spring	Computational
BNB 568: Statistics and Data Analysis II	2	Spring	Computational
BNB 560: Intro to Mammalian Neuroanatomy	1	Spring	Neuroanatomy

Research skills are at the center of the program and all students are required to complete a minimum of 10 credits of research related courses comprised of Introduction to Neuroscience Research, Neuroscience Research Practicum, and Neuroscience Thesis work. In these courses, students will be introduced to innovative neuroscience research techniques through participation in ongoing research in the laboratory of a Department of Neurobiology and Behavior or associated faculty member. These studies form the basis of a written Master's Thesis that is required at the culmination of the program.

While most courses are offered in Fall and Spring semesters, some courses are offered in the Summer Session, including the introductory course, NEU 501. It is suggested that all students enroll in at least 0 credits for NEU 548 during summer session if they are working in labs. A full list of BNB and NEU courses can be found in the Graduate Catalog and are listed by Core Courses and Elective Courses on our website.

See **Appendix I: Sample Course Schedules** and **Appendix II: Graduation Checklist** for more details. Note that course electives may be substituted in sample schedules at the discretion of the Program Director.

GRADUATE SCHOOL POLICIES

The Stony Brook University Graduate School is the governing body that coordinates the written Policies and Procedures for all graduate programs, including registration requirements, academic standing, grading policies, and taking a semester off. The Graduate Catalog includes student policies, degree requirements, and a list of all graduate courses and programs at the University. While the MS Program in Neuroscience has its own guidelines, they ultimately fall within the scope of the Graduate School Policies and degree requirements.

The Graduate School has a helpful Current Student Resources page where they publish a detailed Academic Calendar with deadlines, forms for adding/dropping courses late & requesting a leave of absence, and many additional resources for graduate students. Listed is also a helpful Road Map for New Students to follow when first arriving at Stony Brook which includes information about orientation, housing and obtaining New York residency.

See **Appendix III: Graduate Student Campus Resources** to view a list of online and campus resources available to Graduate Students.

TIME TO DEGREE

Students typically begin their studies in the Summer Session with their cohort of incoming students. This timeline enables students to rapidly initiate thesis research in labs. Students with strong backgrounds and advanced research skills can potentially complete the program in 18 months. Most students complete the program within 24 months. Part-time options are available, although it is expected that all students will complete the degree within a three-year period.

Full-time students in the Masters of Science in Neuroscience Program will take a minimum of 9 credits per semester. Students finish their degree within 1.5-2 years, on average.

Course plans vary slightly by student, and some students may take more than 30 credits before they have completed all additional degree requirements. In addition to completing at least 30 credits of coursework, students must complete a written research thesis. The amount of time the research and writing takes may also vary between students.

TUITION / FEES

Details on tuition/fees can be found here:
Bursar's Tuition & Fees information – See Graduate tuition rate table.

FINANCIAL AID / TEACHING ASSISTANTSHIP

While the Master's Program in Neuroscience does not directly offer financial aid, we are often able to facilitate Adjunct Teaching Assistantships or other short-term jobs for students with the Undergraduate Biology department once students arrive on campus TA positions come with a stipend and a tuition waiver for 1 class. Occasionally advanced MS students receive support from their lab. Additional Graduate Admissions and Financial Aid information can be found on the Graduate School website.

GRADUATION PROCESS

The following are suggested steps for a student who knows the semester they intend to graduate:

1. **Enroll in credits for the final semester.**
   Students must enroll in a minimum of 1 credit in their final semester, unless that semester is winter or summer, in which case domestic students may enroll in 0 credits. Students in their final semester will register for NEU 549 Research Thesis instead of NEU 548 Research Practicum. See the Graduate School page on awarding graduate degrees for more details.

2. **Apply for Graduation through SOLAR.**
   (see Graduate School Academic Calendar or the appropriate semester graduate calendar from the Office of the Registrar for deadlines)

3. **Inform Program Director and Coordinator of your plans a semester ahead of time (if possible).**
   Coordinator will then verify that you will have everything complete by the end of your intended graduation semester using the degree checklist (see Appendix II: Graduation Checklist).
4. **Complete thesis and obtain committee approval.**

5. **Let the Program Director & Coordinator know if you plan to attend Commencement and**

associated Biology Convocation ceremony. There will be attendance forms to fill out for each ceremony.

6. **Complete the Student Exit Survey.**
   A survey link will be sent to you by the Program Coordinator around the end of the semester you intend to graduate. This short survey asks you to tell us your future plans and helps us celebrate your accomplishments!

DEPARTMENT SEMINARS AND EVENTS

Prominent outside speakers are invited to visit our department and centers to discuss their work in a formal seminar during Fall and Spring semesters. Students may get credit for attending through course BNB 697, "Neuroscience Seminar Series."

In the Fall Semester, the first six seminars are organized around a specific field of basic Neuroscience Research. The last four seminars of the Spring Semester are organized to learn about the most cutting-edge approaches to the study of the Neurobiology of Diseases. All other seminars are presented by speakers whose work covers several aspects of brain research, from molecular to cognitive neuroscience. These weekly seminars are part of the training for students enrolled in the Program in Neuroscience and provide an opportunity for students and faculty to interact with outstanding Neuroscientists. Students are expected to regularly attend the seminar series events regardless of their enrollment in the formal seminar related courses.

Seminar speakers will be announced via emailed invitations and the schedule updated online. Students will also receive emails at their stonybrook.edu email address about Graduate School Professional Development events, job and fellowship opportunities, Department seminars, and other department events. View other current updates on the department Twitter (@SBUNeurobiology) or website.

GENERAL OFFICE / LAB POLICIES

Lab mentors/Principal Investigators (PI's) will have their own procedures about sharing lab space and department resources. They will instruct students on getting keys, building access (through student ID card), conference travel, or anything else non-course related. Students may need to communicate with the administrative assistants in the main office to request use of conference rooms, borrowing laptops/cords, sending and receiving packages, etc.

CONTACT INFORMATION

Students may contact the MS Program Director or Program Coordinator at any time with questions or concerns about their experience as a student. The Coordinator can help locate resources on campus and help with the logistics of carrying out a process, but most research and course-related questions can be directed to MS Program Director.

MS Program Director:
Dr. Mary Kritzer
Mary.Kritzer@stonybrook.edu

MS Program Coordinator:
Dr. Lindsey Czarnecki
Lindsey.Czarnecki@stonybrook.edu

CHAPTER 2: THESIS GUIDELINES

This document separately outlines guidelines for the organization and preparation of (1) a research-based thesis and (2) a scholarly literature review thesis. Each includes the required and recommended sections and content standards. There is also a PDF that is appended at the end of this document that describes the steps for developing a scholarly, literature-based review:

> *Pautasso, M (2013) Ten simple rules for writing a literature review. PLoS Comput Biol, doi: 10.1371/journal.pcbi.1003149*

Both document types should be prepared in close consultation with PI/mentors. Students should anticipate multiple rounds of drafts, feedback and revisions in the writing and plan accordingly.

Once a final version of the thesis has been agreed upon and approved by the mentor/PI, the document must be shared with a second reader. Students and PIs/mentors should arrange this in advance and make sure the second reader is aware of any deadlines for review. The second reader should be a full-time faculty member from any Department of Stony Brook or any other college or university; expertise in the field is recommended but the selection and selectin criteria for the second reader are left to the student in consultation with PI/mentor.

The second reader must also approve the document. The second reader may also choose to provide feedback (optional) that can be dependent (edits MUST be made in order for the document to be approved) or independent (edits are suggested) of approval.

Once the document has been approved by the PI/mentor and the second reader, it needs to be forwarded to the Director of the MS Program in Neuroscience for final sign-off. The Program Administrator will advise about deadlines for final submission to the Program Director for timely completion of degree requirements and graduation.

> **NOTE**: AI is generally not to be used; any use of AI needs to be clearly described for approval by readers.

PART 1: RESEARCH-BASED THESIS

1. Sections

a. Preliminary Pages

- Title page
- Abstract (250-500 words): Abstracts must include *ALL* key elements of the thesis- rationale/introduction, methods, results, and relevance. It may be useful to work on the abstract first to get a sense of the overall message of your thesis and assist in organizing and planning the key components. However, it will likely be essential to revisit and substantially re-write the abstract at the end of the writing process to make sure it accurately conveys the main messages of your thesis. One approach to writing abstracts is to use the FIRST SENTENCE to describe the data that will be presented to immediately orient readers to what is to come. "The data presented in my thesis show that…"…and then go on to introduce the background and rationale.
- Dedication Page (optional)
- Table of Contents
- List of Figures/Tables/Illustrations
- List of Abbreviations (optional)
- Acknowledgements (optional)

b. Main Body

i. Introduction (3 -10 pages recommended). The introduction section should provide readers with enough background/context information to understand the topic of the thesis. Subheadings may be especially useful in organizing this information. Recall from NEU 502 that a good introduction will:

- Grab the reader's attention and engage their interest in learning more about the thesis.
- Review the relevant and up to date literature (with proper citations!) that is related to the topic in such a way that readers do NOT have to read these articles for themselves. This summarizes what is known.
- Identify the unanswered questions or areas associated with your topic where current knowledge is lacking; this will summarize the gaps that your work will help address/fill.
- Articulate a clear guiding research question/hypothesis.
- Explain why the research is important and its potential implications.
- Briefly summarize the study's goals and methods.

ii. Methods (pages as needed). Recall from NEU 502: The methods section will provide all information the reader needs to evaluate research validity. Sufficient detail about how experiments were done should also be provided such that anyone can replicate the experiments. It is important that this part of the thesis be clear and written very simply. In sum, this section- and its subsections below- must provide a clear and precise description of who the subjects of the study were, how the experiments were done, and how the data were analyzed.

Recommended subsections:

- Subjects/participants (including a statement, if applicable, that research was conducted under IRB/IACUC approval),
- Materials and equipment (this can also be integrated into the procedures)
- Procedures, written in a level of detail sufficient for replicating the experiments.
- Analysis, describing the statistical tests and other criteria used to interpret or evaluate results.

iii. Results (pages as needed). The results section is a logically organized statement of experimental findings. The results should be stated very simply, and without any interpretation or bias. They should be supported where appropriate by tables, figures and outcomes from statistical testing. You may want to have the APA website handy for how to report statistical findings. Much more than the p-value will be required. Although it is tempting to add a sentence or two about what the results may mean, leave that for the Discussion. As with many parts of the thesis, subheadings can be very useful to help with organization and clarity. Recall and apply the checklist below for results sections from NEU 502:

- I have completed the collection of data and all of the analyses.
- I have included all of and only the results that are most relevant to my thesis research questions.
- I have clearly reported each result and where appropriate I have substantiated findings with quantitative data and with descriptive and inferential statistics.
- I have used tables and figures to illustrate main results where appropriate.
- All tables and figures are correctly labelled, have clearly understandable legends and are referred to in order in the text.
- My results sections do not contain statements about subjective interpretation or speculation on the meaning of my data.

iv. Discussion (3-10 pages recommended). This is the section for summary and interpretation. Most discussions begin with a restatement of the purpose of the study and the gaps it was intended to address, followed by a brief summary of key findings. This section can also compare the findings with previous literature, highlight agreements or disagreements or contradictions, explore possible mechanisms or explanations, and outline the broader implications of the work. Finally, this section can also discuss future directions to further elucidate potential hypothesized conclusions. This is your opportunity to think freely and deeply about the work you have done, what you think it means and what you think it could mean to researchers in the future. Recall and apply the checklist below for discussion sections from NEU 502:

- Remind readers of the rationale/relevance of your research project.
- Describe the knowledge gap you were trying to fill.
- Summarize your findings and tease how they have fulfilled the original rationale.
- Include all results relevant to the rationale/driving questions (even if not statistically significant).

- Discuss your findings in the context of answering your hypothesis. Instead of making statements like "[The first result] was this…," say, "[The first result] suggests [conclusion]."
- Discuss whether your data and conclusions line up with existing literature. If your conclusions are unexpected and aren't aligned with current literature, explain.
- Address any limitations of your study and how relevant they are to interpreting your results and validating your findings.
- Recommend next steps.

v. References. The style is up to you

vi. Appendix (optional)

vii. Index (optional)

c. **Figures and Tables.** These must be numbered and include stand along legends that describe the image/data and explain all abbreviations that may appear in the figure. These can be embedded/placed within the text near where they are being discussed. All figures and tables included must be referred to somewhere in the text.

2. Requirements

- There must be at least 1 original data figure or table with a legend included in the thesis that describes some aspect of the work you have done. Ideally this would be a result. Additional figures can include a visual representation or schematic of information.
- While key, historical works are important to include, the Introduction and Discussion sections must also include references published within the last 5 years, and ideally within the current year of your submission.

3. Resources

The Graduate School at Stony Brook University has provided an example thesis template. This is optional, but helpful in maintaining the organization indicated above.

PART 2: LITERATURE-BASED SCHOLARLY THESIS

1. Sections

a. **Preliminary Pages**

- Title page
- Abstract (250-500 words): Abstracts must include *ALL* key elements of the thesis-rationale/introduction, methods, results, and relevance. It may be useful to work on the abstract first to get a sense of the overall message of your review and assist in organizing and planning the key components. However, it will likely be essential to revisit and substantially re-write the abstract at the end of the writing process to make sure it accurately conveys the main messages of your thesis. One approach to writing abstracts is to use the FIRST SENTENCE to describe what exactly the review will focus on to immediately orient readers to what is to come. "The research presented in this review address questions of…"…and then go on to introduce the background and rationale.
- Dedication Page (optional)
- Table of Contents
- List of Figures/Tables/Illustrations
- List of Abbreviations (optional)
- Acknowledgements (optional)

b. **Main Body**

i. Introduction (3 -10 pages recommended). The introduction section should provide readers with enough background/context information to understand the topic of the review. Subheadings may be especially useful in organizing this information. Adapted from NEU 502; a good introduction will:

- Grab the reader's attention and engage their interest in learning more about the literature that is being reviewed.
- Define key neurobiological concepts and terms that the reader will need.
- Provide an overview of the relevant and up to date literature (with proper citations!) that is related to the topic in such a way that readers do NOT have to read these articles for themselves. This summarizes what is known.
- Identify the unanswered questions or areas associated with your review where current knowledge is lacking or where some disagreement in the literature exists; this will summarize the gaps that your review will highlight and suggest for addressing/filling in the future.
- Articulate the scope and focus of the review
- Explain why the review is necessary at this point in neuroscientific history.
- Briefly summarize the review's goals and methods.

ii. Methods (pages as needed). For a literature-based, scholarly thesis, the methods section should include details of how references were obtained. This includes the databases used, keywords, and method by which papers were included or excluded.

iii. Body/Results (Pages as needed). Group your reviewed literature by theme or methodology, rather than strictly chronologically. Compare and contrast opposing findings, and note where different methodologies may have yielded different results. Use subheadings to add clarity and organization where needed.

iv. Discussion (3-10 pages recommended). This is the section for summary and interpretation. Most discussions begin with a restatement of the purpose of the review and the gaps it was intended to address, followed by a brief summary of key findings or conclusions drawn from the assessments of the literature. This section can also recap key comparisons of findings from prior vs contemporary literature, from studies using differing methods, etc. In sum, highlight agreements or disagreements or contradictions found in the review, and explore what YOU THINK may be possible mechanisms or explanations. Finally, this section can also discuss future directions to further elucidate potential hypothesized conclusions. This is your opportunity to think freely and deeply about the work you have reviewed, what you think it means and what you think it could mean to researchers in the future. Recall and apply the checklist adapted from NEU 502 below:

- Remind readers of the rationale/relevance of your review.
- Describe the knowledge gap you were trying to fill.
- Summarize your findings and tease how they have fulfilled the original rationale.
- Include a summary of what you found in terms of consensus and disagreement by conducting your review.
- Discuss where you stand on open questions and why.
- Address any limitations in your review and how relevant they are to the interpretations you have put forward.
- Recommend next steps.

v. References. The style is up to you

vi. Appendix (optional)

vii. Index (optional)

c. **Figures and Tables**. These must be numbered and include stand along legends that describe the image/data and explain all abbreviations that may appear in the figure. These can be embedded/placed within the text near where they are being discussed. All figures and tables included must be referred to somewhere in the text. These must be original. If a figure is modeled on a figure or diagram from the literature, you must state this clearly in the legend and provide the reference that guides readers to the original figure.

2. Requirements

- There must be at least 1 original figure or table with a legend included in the review that describes some aspect of the work you are presenting or your interpretation of it. Additional figures can include visual representations of key concepts or schematics of information.

- While key historical works are important to include, the Introduction and Discussion sections must include references published within the last 5 years, and ideally within the current year of your submission.

3. Resources

The Graduate School at Stony Brook University has provided an example thesis template. This is optional, but helpful in maintaining the organization indicated above.

Appendix I: Sample Course Schedules

Sample Schedule I: Molecular-Focused
Sample Schedule II: Cellular and Systems-Focused
Sample Schedule III: Computational-Focused

Please note that full-time status is 9 credits.

Sample Schedule I: Molecular-Focused

Course	Credits
Summer Year 1	
NEU 501: Introduction to Neuroscience Research	3
Fall Year 1	
NEU 502: Reading, Writing and Speaking Neurobiology	2
NEU 522: Introduction to Molecular Neuroscience	3
BNB 567: Statistics and Data Analysis I: Foundations	2
NEU 548: MS Research Practicum in Neuroscience	4
BNB 697: Neuroscience Seminar Series	1
Spring Year 1	
NEU 531: Sensory and Motor Systems	2
NEU 532: Neural Plasticity, Learning and Memory	2
BNB 560: Introduction to Mammalian Neural Anatomy	1
NEU 548: MS Research Practicum in Neuroscience	6
BNB 697: Neuroscience Seminar Series	1
Summer Year 2	
NEU 549: MS Thesis Research in Neuroscience	3
Total (including electives)	**30**

Sample Schedule II: Cellular and Systems-Focused

Course	Credits
Summer Year 1	
NEU 501: Introduction to Neuroscience Research	3
Fall Year 1	
NEU 502: Reading, Writing and Speaking Neurobiology	2
NEU 521: Introduction to Cellular Neuroscience	3
BNB 567: Statistics and Data Analysis I: Foundations	2
NEU 548: MS Research Practicum in Neuroscience	1
BNB 697: Neuroscience Seminar Series	1
Spring Year 1	
NEU 531: Sensory and Motor Systems	2
NEU 532: Neural Plasticity, Learning and Memory	2
BNB 560: Introduction to Mammalian Neural Anatomy	1
NEU 548: MS Research Practicum in Neuroscience	2
BNB 697: Neuroscience Seminar Series	1
Summer Year 2	
NEU 548: MS Research Practicum in Neuroscience	3
Fall Year 2	
NEU 549: MS Thesis Research in Neuroscience	3
Electives	3
Total (including electives)	**30**

Sample Schedule III: Computational-Focused

Course	Credits
Summer Year 1	
NEU 501: Introduction to Neuroscience Research	3
Fall Year 1	
NEU 502: Reading, Writing and Speaking Neurobiology	2
NEU 521: Introduction to Cellular Neuroscience	3
BNB 567: Statistics and Data Analysis I: Foundations	2
NEU 548: MS Research Practicum in Neuroscience	2
BNB 697: Neuroscience Seminar Series	1
Spring Year 1	
NEU 531: Sensory and Motor Systems **OR** NEU 532: Neural Plasticity, Learning and Memory	2
NEU 536: Introduction to Computational Neuroscience	2
BNB 560: Introduction to Mammalian Neural Anatomy	1
BNB 568: Statistics and Data Analysis II: Applications	2
NEU 548: MS Research Practicum in Neuroscience	1
BNB 697: Neuroscience Seminar Series	1
Summer Year 2	
NEU 548: MS Research Practicum in Neuroscience	3
Fall Year 2	
NEU 547: Introduction to Neural Computation	3
NEU 549: MS Thesis Research in Neuroscience	3
Total (including electives)	**30+**

Appendix II: Graduation Checklist

MS in Neuroscience Degree Requirements Checklist

Administrative checklist used for degree completion; listed here for optional student reference.

Student Name:	**Entry Semester:**
SBU ID:	**Anticipated Grad. Semester:**
Mentor:	**Communications:**

- ☐ At least 8 credits from, with at least one taken from each category:
  - ☐ Cellular & Molecular:
    - ___ NEU 521 Introduction to Cellular Neuroscience
    - ___ NEU 522 Introduction to Molecular Neuroscience
  - ☐ Computational:
    - ___ BNB 567 Statistics and Data Analysis in Neuroscience I: Foundations
    - ___ BNB 568 Statistics and Data Analysis in Neuroscience II: Applications
    - ___ NEU 536 Introduction to Computational Neuroscience
    - ___ NEU 547 Introduction to Neural Computation
  - ☐ Systems:
    - ___ NEU 531 Sensory and Motor Systems
    - ___ NEU 532 Neural Plasticity, Learning, and Memory
  - ☐ Neuroanatomy:
    - ___ BNB 560 Introduction to Mammalian Neuroanatomy
- ☐ 4 credits from seminar courses:
  - ___ NEU 502 Reading, Writing, and Speaking Neurobiology
  - ___ BNB 697 Neuroscience Seminar Series
- ☐ 10 credits in research courses:
  - ___ NEU 501 Introduction to Neuroscience Research
  - ___ NEU 548
  - ___ NEU 549
- ☐ 30 total credits in graduate courses (500-600 level) (Note a C grade is required to receive credit):
  - ___ NEU 534 Principles of Neurobiology
  - ___ Additional courses
- ☐ Cumulative 3.0 GPA in graduate courses
- ☐ Completed within the 3 or 5-year time frame (depending on FT or PT status)
- ☐ Registered for at least 1 graduate credit if graduating in spring/fall semesters; can register for 0 credits if graduating in winter/summer semesters
- ☐ Informed the Graduate Program Coordinator and Program Director of plan to graduate and student plans for attending commencement events
- ☐ Completed and approved thesis. Date committee approved:
- ☐ All grades assigned (no blanks or outstanding "I" grades)
- ☐ Exit Survey (Google Form) completed
- ☐ Completion of MS Degree Requirements form signed and sent to the Graduate School

Additional Notes:

Signature of Person Verifying Checklist: Date:

Appendix III: Graduate Student Campus Resources

The Graduate School has a helpful Current Student Resources page where they publish a detailed Academic Calendar with Deadlines, Forms for adding/dropping courses late and requesting a leave of absence, and many additional resources for graduate students. Listed is also a helpful New Student Road Map to follow when first arriving at Stony Brook which includes information about orientation, housing and obtaining New York residency.

Here is a list of commonly-requested resources & notes for our current students:

- Our department may email you about events, upcoming deadlines, student resources, etc., or you can catch up with news on Twitter @SBUNeurobiology.

- The SBU Center for Inclusive Education promotes professional development and fosters diversity and inclusion by providing opportunities for community events, fellowships, mentoring relationships, and other resources

- Student Counseling and Psychological Services. CAPs has online counseling available for free to all enrolled students.

- The Writing Center helps students improve writing skills. Appointments can be made to meet with Writing Center Tutors.

- There is a Food Pantry on campus, whose website also lists other local food pantries and food insecurity resources. You can also use the Feeding America website to find local food resources in other parts of the country.

- More Information specific to New Student Insurance and Health Forms is found on the Student Health Service site.

- The Office of Diversity, Inclusion and Intercultural Initiatives on campus provides many resources, including this list of programs, organizations, and events on campus that foster diversity, and SBU's Caring, Respect, Civility website.

- The SBU Center for Prevention and Outreach has many resources for students including for sexual violence and mental health.

- University Police Department resources on campus safety, including SB Guardian app and the Walk Service Program for those who would like company when travelling between points on campus at night. You can also stay up to date on campus news and alerts.

- If you have a physical, hearing, vision, cognitive, or psychological disability, you can receive accommodations from the Student Accessibility Support Center for academic, housing, and temporary conditions.

Note that student employees can get disability accommodation help for their jobs via the ADA specialist at the Office of Equity and Access. This Office also handles all claims of discrimination for students, staff, and faculty.

OPEN ACCESS Freely available online

PLOS | COMPUTATIONAL BIOLOGY

Editorial

Ten Simple Rules for Writing a Literature Review

Marco Pautasso[1,2]*

1 Centre for Functional and Evolutionary Ecology (CEFE), CNRS, Montpellier, France, **2** Centre for Biodiversity Synthesis and Analysis (CESAB), FRB, Aix-en-Provence, France

Literature reviews are in great demand in most scientific fields. Their need stems from the ever-increasing output of scientific publications [1]. For example, compared to 1991, in 2008 three, eight, and forty times more papers were indexed in Web of Science on malaria, obesity, and biodiversity, respectively [2]. Given such mountains of papers, scientists cannot be expected to examine in detail every single new paper relevant to their interests [3]. Thus, it is both advantageous and necessary to rely on regular summaries of the recent literature. Although recognition for scientists mainly comes from primary research, timely literature reviews can lead to new synthetic insights and are often widely read [4]. For such summaries to be useful, however, they need to be compiled in a professional way [5].

When starting from scratch, reviewing the literature can require a titanic amount of work. That is why researchers who have spent their career working on a certain research issue are in a perfect position to review that literature. Some graduate schools are now offering courses in reviewing the literature, given that most research students start their project by producing an overview of what has already been done on their research issue [6]. However, it is likely that most scientists have not thought in detail about how to approach and carry out a literature review.

Reviewing the literature requires the ability to juggle multiple tasks, from finding and evaluating relevant material to synthesising information from various sources, from critical thinking to paraphrasing, evaluating, and citation skills [7]. In this contribution, I share ten simple rules I learned working on about 25 literature reviews as a PhD and postdoctoral student. Ideas and insights also come from discussions with coauthors and colleagues, as well as feedback from reviewers and editors.

Rule 1: Define a Topic and Audience

How to choose which topic to review? There are so many issues in contemporary science that you could spend a lifetime of attending conferences and reading the literature just pondering what to review. On the one hand, if you take several years to choose, several other people may have had the same idea in the meantime. On the other hand, only a well-considered topic is likely to lead to a brilliant literature review [8]. The topic must at least be:

(i) interesting to you (ideally, you should have come across a series of recent papers related to your line of work that call for a critical summary),

(ii) an important aspect of the field (so that many readers will be interested in the review and there will be enough material to write it), and

(iii) a well-defined issue (otherwise you could potentially include thousands of publications, which would make the review unhelpful).

Ideas for potential reviews may come from papers providing lists of key research questions to be answered [9], but also from serendipitous moments during desultory reading and discussions. In addition to choosing your topic, you should also select a target audience. In many cases, the topic (e.g., web services in computational biology) will automatically define an audience (e.g., computational biologists), but that same topic may also be of interest to neighbouring fields (e.g., computer science, biology, etc.).

Rule 2: Search and Re-search the Literature

After having chosen your topic and audience, start by checking the literature and downloading relevant papers. Five pieces of advice here:

(i) keep track of the search items you use (so that your search can be replicated [10]),

(ii) keep a list of papers whose pdfs you cannot access immediately (so as to retrieve them later with alternative strategies),

(iii) use a paper management system (e.g., Mendeley, Papers, Qiqqa, Sente),

(iv) define early in the process some criteria for exclusion of irrelevant papers (these criteria can then be described in the review to help define its scope), and

(v) do not just look for research papers in the area you wish to review, but also seek previous reviews.

The chances are high that someone will already have published a literature review (Figure 1), if not exactly on the issue you are planning to tackle, at least on a related topic. If there are already a few or several reviews of the literature on your issue, my advice is not to give up, but to carry on with your own literature review,

(i) discussing in your review the approaches, limitations, and conclusions of past reviews,

(ii) trying to find a new angle that has not been covered adequately in the previous reviews, and

(iii) incorporating new material that has inevitably accumulated since their appearance.

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When searching the literature for pertinent papers and reviews, the usual rules apply:

(i) be thorough,

(ii) use different keywords and database sources (e.g., DBLP, Google Scholar, ISI Proceedings, JSTOR Search, Medline, Scopus, Web of Science), and

(iii) look at who has cited past relevant papers and book chapters.

Rule 3: Take Notes While Reading

If you read the papers first, and only afterwards start writing the review, you will need a very good memory to remember who wrote what, and what your impressions and associations were while reading each single paper. My advice is, while reading, to start writing down interesting pieces of information, insights about how to organize the review, and thoughts on what to write. This way, by the time you have read the literature you selected, you will already have a rough draft of the review.

Of course, this draft will still need much rewriting, restructuring, and rethinking to obtain a text with a coherent argument [11], but you will have avoided the danger posed by staring at a blank document. Be careful when taking notes to use quotation marks if you are provisionally copying verbatim from the literature. It is advisable then to reformulate such quotes with your own words in the final draft. It is important to be careful in noting the references already at this stage, so as to avoid misattributions. Using referencing software from the very beginning of your endeavour will save you time.

Rule 4: Choose the Type of Review You Wish to Write

After having taken notes while reading the literature, you will have a rough idea of the amount of material available for the review. This is probably a good time to decide whether to go for a mini- or a full review. Some journals are now favouring the publication of rather short reviews focusing on the last few years, with a limit on the number of words and citations. A mini-review is not necessarily a minor review: it may well attract more attention from busy readers, although it will inevitably simplify some issues and leave out some relevant material due to space limitations. A full review will have the advantage of more freedom to cover in detail the complexities of a particular scientific development, but may then be left in the pile of the very important papers "to be read" by readers with little time to spare for major monographs.

There is probably a continuum between mini- and full reviews. The same point applies to the dichotomy of descriptive vs. integrative reviews. While descriptive reviews focus on the methodology, findings, and interpretation of each reviewed study, integrative reviews attempt to find common ideas and concepts from the reviewed material [12]. A similar distinction exists between narrative and systematic reviews: while narrative reviews are qualitative, systematic reviews attempt to test a hypothesis based on the published evidence, which is gathered using a

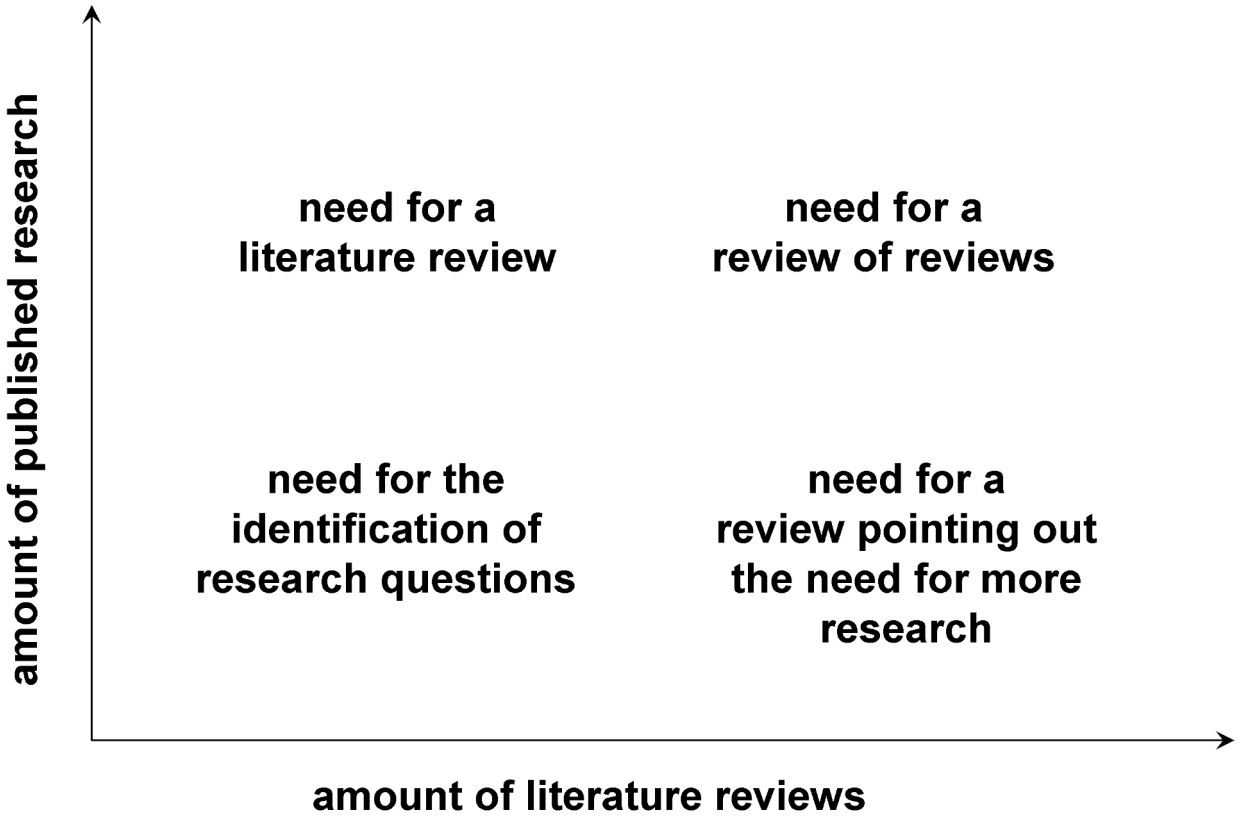

Figure 1. A conceptual diagram of the need for different types of literature reviews depending on the amount of published research papers and literature reviews. The bottom-right situation (many literature reviews but few research papers) is not just a theoretical situation; it applies, for example, to the study of the impacts of climate change on plant diseases, where there appear to be more literature reviews than research studies [33].
doi:10.1371/journal.pcbi.1003149.g001

predefined protocol to reduce bias [13,14]. When systematic reviews analyse quantitative results in a quantitative way, they become meta-analyses. The choice between different review types will have to be made on a case-by-case basis, depending not just on the nature of the material found and the preferences of the target journal(s), but also on the time available to write the review and the number of coauthors [15].

Rule 5: Keep the Review Focused, but Make It of Broad Interest

Whether your plan is to write a mini- or a full review, it is good advice to keep it focused [16,17]. Including material just for the sake of it can easily lead to reviews that are trying to do too many things at once. The need to keep a review focused can be problematic for interdisciplinary reviews, where the aim is to bridge the gap between fields [18]. If you are writing a review on, for example, how epidemiological approaches are used in modelling the spread of ideas, you may be inclined to include material from both parent fields, epidemiology and the study of cultural diffusion. This may be necessary to some extent, but in this case a focused review would only deal in detail with those studies at the interface between epidemiology and the spread of ideas.

While focus is an important feature of a successful review, this requirement has to be balanced with the need to make the review relevant to a broad audience. This square may be circled by discussing the wider implications of the reviewed topic for other disciplines.

Rule 6: Be Critical and Consistent

Reviewing the literature is not stamp collecting. A good review does not just summarize the literature, but discusses it critically, identifies methodological problems, and points out research gaps [19]. After having read a review of the literature, a reader should have a rough idea of:

(i) the major achievements in the reviewed field,

(ii) the main areas of debate, and

(iii) the outstanding research questions.

It is challenging to achieve a successful review on all these fronts. A solution can be to involve a set of complementary coauthors: some people are excellent at mapping what has been achieved, some others are very good at identifying dark clouds on the horizon, and some have instead a knack at predicting where solutions are going to come from. If your journal club has exactly this sort of team, then you should definitely write a review of the literature! In addition to critical thinking, a literature review needs consistency, for example in the choice of passive vs. active voice and present vs. past tense.

Rule 7: Find a Logical Structure

Like a well-baked cake, a good review has a number of telling features: it is worth the reader's time, timely, systematic, well written, focused, and critical. It also needs a good structure. With reviews, the usual subdivision of research papers into introduction, methods, results, and discussion does not work or is rarely used. However, a general introduction of the context and, toward the end, a recapitulation of the main points covered and take-home messages make sense also in the case of reviews. For systematic reviews, there is a trend towards including information about how the literature was searched (database, keywords, time limits) [20].

How can you organize the flow of the main body of the review so that the reader will be drawn into and guided through it? It is generally helpful to draw a conceptual scheme of the review, e.g., with mind-mapping techniques. Such diagrams can help recognize a logical way to order and link the various sections of a review [21]. This is the case not just at the writing stage, but also for readers if the diagram is included in the review as a figure. A careful selection of diagrams and figures relevant to the reviewed topic can be very helpful to structure the text too [22].

Rule 8: Make Use of Feedback

Reviews of the literature are normally peer-reviewed in the same way as research papers, and rightly so [23]. As a rule, incorporating feedback from reviewers greatly helps improve a review draft. Having read the review with a fresh mind, reviewers may spot inaccuracies, inconsistencies, and ambiguities that had not been noticed by the writers due to rereading the typescript too many times. It is however advisable to reread the draft one more time before submission, as a last-minute correction of typos, leaps, and muddled sentences may enable the reviewers to focus on providing advice on the content rather than the form.

Feedback is vital to writing a good review, and should be sought from a variety of colleagues, so as to obtain a diversity of views on the draft. This may lead in some cases to conflicting views on the merits of the paper, and on how to improve it, but such a situation is better than the absence of feedback. A diversity of feedback perspectives on a literature review can help identify where the consensus view stands in the landscape of the current scientific understanding of an issue [24].

Rule 9: Include Your Own Relevant Research, but Be Objective

In many cases, reviewers of the literature will have published studies relevant to the review they are writing. This could create a conflict of interest: how can reviewers report objectively on their own work [25]? Some scientists may be overly enthusiastic about what they have published, and thus risk giving too much importance to their own findings in the review. However, bias could also occur in the other direction: some scientists may be unduly dismissive of their own achievements, so that they will tend to downplay their contribution (if any) to a field when reviewing it.

In general, a review of the literature should neither be a public relations brochure nor an exercise in competitive self-denial. If a reviewer is up to the job of producing a well-organized and methodical review, which flows well and provides a service to the readership, then it should be possible to be objective in reviewing one's own relevant findings. In reviews written by multiple authors, this may be achieved by assigning the review of the results of a coauthor to different coauthors.

Rule 10: Be Up-to-Date, but Do Not Forget Older Studies

Given the progressive acceleration in the publication of scientific papers, today's reviews of the literature need awareness not just of the overall direction and achievements of a field of inquiry, but also of the latest studies, so as not to become out-of-date before they have been published. Ideally, a literature review should not identify as a major research gap an issue that has just been addressed in a series of papers in press (the same applies, of course, to older, overlooked studies ("sleeping beauties" [26])). This implies that literature reviewers would do well to keep an eye on electronic lists of papers in press, given that it can take months before these appear in scientific databases. Some reviews declare that they

have scanned the literature up to a certain point in time, but given that peer review can be a rather lengthy process, a full search for newly appeared literature at the revision stage may be worthwhile. Assessing the contribution of papers that have just appeared is particularly challenging, because there is little perspective with which to gauge their significance and impact on further research and society.

Inevitably, new papers on the reviewed topic (including independently written literature reviews) will appear from all quarters after the review has been published, so that there may soon be the need for an updated review. But this is the nature of science [27–32]. I wish everybody good luck with writing a review of the literature.

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