New Graduate Course Proposal Form

Faculty of Science

The following information is required for all new course proposals. Provide evidence of consultation, where appropriate. To facilitate the review/approval process, please use the headings below (and omit the italicized explanations below each heading).

All new course proposals must include a library statement.

**1. Graduate Program:** BIOLOGY

**2. Responsible Unit:** Faculty of Science, Department of Biology

**3. Subject Code (Rubric) and Course Number:** GS/BIOL 5150

**4. Credit Value:** 1.5

**5. Long Course Title:** Critical use and appraisal of meta-analyses and systematic reviews

**6. Short Course Title:** Critical meta-analyses and reviews

**7. Effective Term/Calendar Year:**

Fall 2022

**8. Language of Instruction:**

English

**9. Calendar (Short) Course Description:**

Scientific synthesis of all academic evidence from data to papers can promote evidence-informed decision making. Every contemporary discipline has some capacity to support and benefit from synthesis tools. Here, we develop a set of heuristics to support innovation and leverage evidence through meta-analyses and systematic reviews. A graduate-level statistics course is a pre-requisite for this course.

**10. Expanded Course Description:**

**The course is developed and published in full here as an open, free e-book reader:**<https://bookdown.org/chris/quantitative_synthesis_tools/>

**Outline**

1 Introduction to synthesis in science: Examine the scope and extent of synthesis in contemporary science for many disciplines.

2 Quantitative synthesis tools: Explore conceptual and mental models for synthesis.

3 Evidence workflow reporting: Develop reporting documentation from a formal synthesis review process.

4 Meta-analysis in R: Develop a template for derived data for analyses, and complete a meta-analysis in R.

5 Interpretation of meta-analyses: Examine model outputs from meta-analyses and interpret. Identify key components.

6 Coursework: A summary of the steps needed to complete summative assessment including rubrics

**11. Course Learning Outcomes:**

Critically review peer-reviewed journal publications.

Engineer syntheses and solutions from published evidence.

Appreciate strengths of different synthesis tools and reporting.

Do a meta-analysis or systematic review.

**12. Rationale:**

Scientific synthesis of published evidence in all disciplines is a critical professional skill as an academic. This course consolidates critical thinking in reading the work of others, reusing evidence, and addressing open and more inclusive, diverse science because transparency in scientific reporting is paramount to progress and evidence-informed science. There are many offerings in the Biology graduate program that address examination of topics including GS/BIOL5027 Topics in Molecular Biology I: Gene Expressions, GS/BIOL 5028 Topics in Molecular Biology II: Proteins, GS/BIOL 5088 Advanced Topics in Ecology and Evolution, GS/BIOL 5098 Conservation Biology, and GS/BIOL 5128 Current Topics in Comparative and Intergrative Animal Pysiology to name a few. This specific offering directly augments all these offerings because it provides framing and tools to evaluate the relative strength of evidence in published literature. It also extends GS/BIOL 5081  Intro. To Biostatistics that focusses on establishing strong skills in R and open biostatistical analyses. This course consolidates statistical thinking and reason for the sciences. Finally, it does not overlap with the focussed critical skills offerings such as GS/BIOL 5100 Critical Skills in Animal Physiology or GS/BIOL 5086  Critical Skills in Ecology and Evolution that focus more specifically on these fields of study and effective oral and written communication. It supports and consolidate principles but does not overlap with the tools developed in GS/BIOL 5144  Computer Programming for Experimental Psychology.

**13. Evaluation:**

Three summative exercises are associated with successful completion of this course.

**Assignment 1: evidence maps**

Design an ‘evidence map for evidence gaps’ or ‘evidence map as a geographic map’ for a topic of your choice in your expertise or domain of research.

**Steps**

Select a topic and pilot appropriate search terms to populate a representative and reasonable set of peer-reviewed publications. Use The Web of Science or other relevant bibliometric resource. Secure at least 50 papers for first review.

Review these primary studies for relevance, available data, concept of interest or hypothesis directly tested, and other criteria identified for your synthesis.

Generate a PRISMA workflow diagram and briefly describe exclusion criteria.

Using the included instances, compile frequency of study of key concepts of these primary studies.

Identify the country of study or more specific geographic estimate of study locations.

Record sample sizes of each independent trial from each study.

In processing the list of studies, keep track of potential key measures, outcomes, factors, and also moderators for future and deeper synthesis work on this topic.

If there is an existing systematic review on this topic or set of key terms and it was published at least 2-years ago, it is viable to update this synthesis work. Do the above steps and if a reasonable number of returns is present since date of synthesis publication (i.e. at least 50 recent primary papers), consider updating this work.

Generate your evidence map.

Briefly describe both the search process supporting the PRISMA workflow and the evidence map.

**Total value 30%**

**Assignment 2: ignite commentary**

Based on your synthesis work completed in product 1, provide a short < 2000 word Ignite format contribution appropriate for the journal Oikos that inspired this format of contribution to science.

**Steps**

Identify and describe the challenge or research question(s).

Succinctly summarize what is known.

Describe the evidence gaps and next steps for this specific field of research.

Highlight an implication of this synthesis process for readers.

Cite at least 5 papers relevant to the synthesis summarized as an Ignite paper here.

**Total value 25%**

**Assignment 3: meta-analysis**

Complete a meta-analysis in R for a subset of your studies.

**Steps**

Reuse the studies included in your synthesis in products above.

Extract the mean, sample size, and estimate for variance associated with these measures.

Compile at least 12-15 independent observations for analysis. These can be from a limited number of studies/papers provided the trials/experiments reported in a study or paper were independent. For instance, an experiment was replicated in 3 different grasslands in a paper and data were available for each. This is now commonly treated as independent replications if the ecology or science supports this. Evidence organized into papers is not necessarily single instances.

Identify at least one moderator (categorical or continuous) to explore in subsequent analyses.

Do a meta-analysis using metafor for simple grand mean effect of your key factor.

Explore heterogeneity and bias.

Repeat the meta-analysis and test your moderator.

The goal only 10-15 independent rows or observations here to pilot the statistical process and interpretation for your topic.

Generate a forest plot or meta-regression plot depending on your moderator.

Make a table of key results.

Aggregate the figure and table into a single document and provide a short 2-3 sentence interpretation.

**Total value 45%**

**14. Integrated Courses:**

This course will not be integrated into the undergraduate program.

**15. Cross-listed Courses:**

This course will not be cross-listed.

**16. Enrolment Notes:**

This course is open to all students enrolled in the graduate program at MSc or PhD. Ideally, the course is taken once the students identify their research topic in year 2 of study.

**17. Faculty Resources:**

Professor Lortie is prepared to deliver this course. There is no impact on teaching resources at the departmental level because Lortie has sufficient room in their 1.5 course teaching load to offer this course.

**18. Physical Resources:**

No specific classroom or infrastructure is needed. The programming language used to do analyses is open, free and available on all major computer operating systems. A computer lab is not needed and personal laptops or computers used for primary research in student labs are sufficient.

**19. Bibliography and Library Statement:**

**All readings are published in peer-reviewed journals accessible through the York University library system.**

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Ioannidis, J. P. A. 2005. “Why Most Published Research Findings Are False.” Journal Article. PLoS Med 2. https://doi.org/10.1371/journal.pmed.0020124.

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Kotiaho, J. S., and J. L. Tomkins. 2002. “Meta-Analysis Can It Ever Fail.” Journal Article. Oikos 96: 551–53.

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McKinnon, M. C., S. H. Cheng, R. Garside, Y. J. Masuda, and D. C. Miller. 2015. “Sustainability: Map the Evidence.” Journal Article. Nature 528: 185–87.

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Nakagawa, Shinichi, Daniel W. A. Noble, Alistair M. Senior, and Malgorzata Lagisz. 2017. “Meta-Evaluation of Meta-Analysis: Ten Appraisal Questions for Biologists.” Journal Article. BMC Biology 15 (1): 18. https://doi.org/10.1186/s12915-017-0357-7.

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Page, Matthew J., Joanne E. McKenzie, Patrick M. Bossuyt, Isabelle Boutron, Tammy C. Hoffmann, Cynthia D. Mulrow, Larissa Shamseer, et al. 2021. “The PRISMA 2020 Statement: An Updated Guideline for Reporting Systematic Reviews.” Journal Article. BMJ 372: n71. https://doi.org/10.1136/bmj.n71.

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