

GUIDELINES FOR MCRO710/711/712 COURSES
(approved by 32-1 vote of MCRO faculty January 2021)

Starting in the Spring 2021 semester, all MCRO71X courses are expected to follow the guidelines below, which are organized around the required elements of a UNC course syllabus.

Meeting Times:

- All MCRO71X courses should meet once per week for at least two hours. Students tend to lose attention if the class is much longer than about two hours, but the ability to cover content in desired depth would be compromised with classes that are shorter.

Target Audience:

- It is important to remember that both first and second year graduate students participate in MCRO71X courses, so there is a wide range of ability. More senior students sometimes audit the courses. Activities and content should be compatible with the range of student sophistication, and in particular not leave out the beginners.

Course Goals:

- The primary goal of MCRO71X, and the reason the courses are required for MCRO Ph.D. and M.S. degrees, is to learn the critical thinking skills that are essential to being an effective scientist.
- A benefit of learning critical thinking skills is preparation for the written and oral preliminary examinations. However, course activities should be designed primarily to develop a foundation of critical thinking skills, rather than focus on exam preparation.
- Another goal of MCRO71X is to learn about recent advances in a field and other specialized knowledge by reading the primary scientific literature.

Key Learning Objectives:

- Be able to identify what constitutes good science, including what makes good experimental design, what are appropriate controls, what is a robust statistical analysis, what is significant, what is innovative, etc.
- Be able to identify the strengths and weaknesses of a scientific paper.
- Be able to propose alternative interpretations of the same set of data, design experiments to distinguish between multiple interpretations of a data set, and distinguish between correlation and causation.
- Be able to suggest alternative experimental approaches to address a question, and identify advantages and disadvantages of each.
- Become familiar with a variety of methods to communicate data to a reader, and the strengths and weaknesses of each. This includes awareness of inappropriate or misleading methods.
- Get practice suggesting reasonable ways to extend the line of investigation described in a paper, including suitable Specific Aims for a follow up project.

- Get practice formulating questions to ask a senior investigator following a presentation of their research. In other words, if you heard the author of a paper give a seminar describing their research, what questions would you ask at the end of the seminar?

Course Requirements (i.e. the types of student activities):

- The primary activity used to achieve course goals is discussion of original research articles. Lectures are limited if they occur at all.
- Nevertheless, at least the first class meeting should be led by the instructor(s) and cover strategies and expectations for conducting class activities, dissecting a scientific paper, achieving learning objectives, etc. One example is to discuss the STAR Methods framework required for publication in Cell Press journals.
- To allow sufficient depth of analysis, no more than two original papers should be discussed in a single class meeting. A minireview or commentary may be used to provide relevant background context.
- There should be a reasonable connection between expected student activities and the basis for determining grades.
- The structure of weekly activities is up to the course director, but the format should encourage every student to be intellectually engaged every week. This does not mean participation must be equal every week. However, the extreme scenario of assigning one or two students to present an entire paper to their peers and hoping the other students prepare and participate is not acceptable. Some combination of assigned responsibilities (to ensure accountability) and the possibility of being called upon at any time during class (to encourage preparation) could be successful.

Possibilities include:

- a. Choose students at random during class to present their understanding of a figure (as well as what they do not understand). This should encourage all students to read and think about the entire paper, and is compatible with formats that go through figures in linear or random order, or discuss some or all figures.
- b. If option (a) leads to students who identify what they do not understand but do not make the effort before class to figure things out, then presentation of specific figures can be assigned in advance, with the expectation that the students are fully prepared for at least their figure. The disadvantage of this option is that students may not read the rest of the paper as carefully.
- c. Provide students with a list of topics (perhaps with one key paper for each) at the start of the course. The assigned student(s) investigate the topic in more depth, perhaps suggesting another paper to read, and make a brief presentation to the rest of the class about the field before discussion of the paper(s) begins. This exercise can be coupled with a writing assignment (see next bullet).
- d. Assign a student to moderate the weekly discussion, calling on other students to present various aspects of the paper. This will presumably require a greater degree of preparation from the moderator.
- e. Instead of discussing a paper in its entirety from beginning to end, which may waste time on material everyone understands, the discussion can be driven by students asking questions about anything they do not understand, with the other students attempting to provide answers. If no one asks questions, then the instructor can test the implication of full understanding by asking questions of

their own. A disadvantage is if no students know the answers, then the instructor may carry a disproportionate share of the conversation.

- f. Assign students tasks related but not central to understanding the paper itself. For example: explain key vocabulary words at the start of each class, formulate a question they would ask the author if the contents of the paper were presented at a seminar, propose some ideas for extending the line of investigation reported in the paper for the rest of the class to discuss and evaluate, etc.
- All MCRO71X courses will require a writing assignment of the course director's choosing. Possibilities include:
 - a. Write a mock peer review of a paper.
 - b. Write a "news & views" style commentary about a paper, summarizing the findings and putting them in broader context for a more general audience.
 - c. Write a minireview on the topic exemplified by a paper.
 - d. Describe how the line of investigation described in a paper might be extended, including potential Specific Aims.
 - e. A creative writing assignment based on a scientific topic, e.g. watch a movie based on an infectious disease and write an essay based on provided prompts. This could be structured in a way for the student to employ logical thinking. Options b to d would involve identifying and reading related papers. Options b to e could include preparation of an illustration.

Grading:

- There will be no examinations in MCRO71X.
- The basis for assigning grades is up to the course director, but will likely involve some combination of participation and writing assignment(s).

Creative Deviations:

- Within the provided guidelines, course directors have substantial flexibility in how they conduct MCRO710x courses.
- If a course director has a creative idea for how to conduct MCRO71X that deviates substantially from the traditional paradigm (e.g. discussing the original scientific literature) or these guidelines, then he or she should discuss their plans in advance with the Director of Graduate Studies and the Education & Training Committee to consider how course goals and learning objectives might be met. During such discussions, it is important to remember that M.D./Ph.D. students only take MCRO71X once. It is possible that there may be real value to offering a version of MCRO71X with an unusual format, independent of a decision about whether the course may be counted toward the MCRO graduation requirement for literature-based course(s).