

Master Syllabus for Math Labs (MATH201–206)

AY 2021-22

Course coordinator: Dan Dugger

New information for 2021–22:

1. In June 2021 we changed the Math Labs so that only freshmen and sophomores can register. If a junior or senior wants to register they need to get permission, either from an advisor or from the instructor, and then have Mary process a prerequisite override. I do not think this went into effect soon enough to apply to registration for Fall 2021, but it should be in effect in subsequent quarters. If you have upperclassmen in your Math Lab courses in Fall 2021, you might want to encourage them to talk to an advisor about a more appropriate course they could take.

2. Special information for COVID: It is unclear in the time of COVID to what extent it is wise to have students working in groups with the teacher circulating. Individual instructors will have to make a judgement for themselves about this. Students should probably not be forced to work in groups if they feel unsafe. Also, the instructor should have backup plans ready on Day One for how students who have to miss class can make up any lost credit. If the instructor does not want to arrange the class around group work, a fallback might be to have the class time spent on class discussions led by the instructor, broken up with “think about this for 5 minutes on your own” periods.

There is not a traditional “model syllabus” for these courses, as the choice of course content will vary quite a bit from instructor to instructor in these Math Labs. Even different sections of MATH201 might focus on very different material. However, what I expect will be roughly the same in all Math Labs are the following course goals:

- (1) Help students gain experience in both talking and writing about mathematics.
- (2) Get students away from the idea that math is about learning algorithms and then showing that you can carry them out. We want to help students get on the path of asking questions about why things work, experimenting, and searching for explanations.
- (3) Give students some exposure to mathematics outside of the standard “road to calculus”.

Many Math Labs will be run like a math circle, or involve a flipped classroom in some way. This is not required, though.

We have a Dropbox set up with materials from several former Math Labs. For access, send me an email and I will add you. Also, I have webpages set up for my MATH205 and MATH206 from Fall 2017 and 2018 here:

http://pages.uoregon.edu/ddugger/ma205_fall2017.html

http://pages.uoregon.edu/ddugger/ma206_fall2017.html

http://pages.uoregon.edu/ddugger/ma205_fall2018.html

http://pages.uoregon.edu/ddugger/ma206_fall2018.html

These pages have all the reading and writing assignments I assigned, and all the worksheets I used. The 2017 MA206 class went pretty well, but I think the material from the 2017 MA205 course got too difficult in the second half. In reverse, the 2018 version of MA205 went extremely well, but the 2018 version of MA206 was a flop.

The Math Labs are set up to be 2-credit P/N courses. This means students should be putting in six hours per week, two of which are in the classroom. It is important to set clear guidelines on what will constitute a passing grade, for instance using some kind of point system. See my sample syllabus below for an example.

The following is a brief account of my experiences teaching two Math Labs in Fall 2017. I have a longer version of this I am happy to provide upon request.

1.1. What I did: I organized my Labs so that there was a weekly reading assignment to be done over the weekend, and on Monday the students had to hand in a short piece of writing (one or two paragraphs). Sometimes the writing was very open-ended (e.g. “Write about one thing you understood and one thing you didn’t understand”) and sometimes it was more directed (e.g., “Think about such-and-such problem for one hour and write about what you did to try to solve it.”) In addition to this, I had the students do 5 longer “write-ups” of 1-2 typed pages over the course of the quarter, where they explained a concept or problem in more detail. They handed in 4 drafts throughout the quarter, I read them and gave feedback, and the students were required to revise them and hand everything in as a “Final Portfolio” that was due during finals week. Throughout the quarter, everything was graded on participation and not on whether anything was right or wrong. It was only on the Final Portfolio where they would lose points if things were incorrect.

I didn’t require that students type things, but I tried to encourage it. In particular, I gave students handouts on learning LaTeX and for one of the weekly writing assignments it was required that they use LaTeX. I wish I had focused a bit more of this, but even with minimal focus many students did learn to use the software and regularly handed in their work that way. The website www.overleaf.com seems to work well as an online LaTeX tool. The website cocalc.com is another one, but due to high usage that one gets slow in the middle of the day.

Classroom activities were spent discussing the readings, working problems in a math-circle type format, or (sometimes) lectures.

1.2. What didn't go well: I felt a general lack of engagement from a lot of the students, and they constantly walked the line of doing just enough to barely skate by. Maybe the extent of this was not any more than a calculus class, but the nature of the course (and the small size) made it feel worse to me. If I asked that a write-up be 1–2 pages, many students handed in something that was just a couple paragraphs. Perhaps this was done on the grounds of “I know I'm not going to get penalized, so I will do just enough to get my participation points for this assignment.” It tended to frustrate me. My instructions for the first write-up said something like “write enough to show engagement with the topic, usually 1–2 pages will be sufficient” and what I found out was that the students and I had very different ideas for what “engagement” looked like. I tried to make later assignments much more specific.

Early in the class, I found that students had problems following instructions. If I asked them to write about a topic from the Week 2 worksheet, a few would choose to write about something completely different. The first Write-Up was a complete disaster, and I had to lecture them afterwards about following instructions and actually trying to do a good job. Things improved somewhat at this point, although for the final portfolio several students still did not follow my instructions or hand in their material on time.

After talking with some of the better students at the end of the course, I have some concerns about the P/N format—not enough to strongly argue against it, but enough to raise the question. I worry that without the incentive of a possible “A” grade, students just aren't going to put much effort into the course. Maybe that's okay.

When assigning final grades, I was not thrilled. I used a point system with 100 points and 80 constituted passing, but if I were to do it again I might make passing be 83 or 84. There were too many cases where students passed despite giving a very poor performance. Despite it being very easy to accumulate 90 points, very few students did this. I had about 25% of students in the 90-100 range, 37% in the 85–89 range, and 37% in the 75–81 range. These scores really should have been higher.

I ended up grading the final portfolio as follows. Each Write-Up was worth 5 points, with the rubric being

- 5 great
- 4 good, but a few minor errors
- 3 satisfactory, but needs improvement in either depth or correctness
- 2 deficient in either content or depth, but shows some signs of effort
- 1 minimal effort.

This accounted for 25 of the 26 points for the portfolio. The last point was given based on whether or not the student followed the instructions and handed the portfolio in on time. The average (and median!) grade on the final portfolio was 17.

The writings were, in general, somewhat depressing. A very few of the students were quite decent writers and handed in things that were enjoyable to read, but most of what students handed in had poor grammar or spelling, together with incoherent ideas. Lack of precision and poor explanations were typical.

I do think that good writing skills take time to develop, and mathematical writing has particular qualities that the students have not been trained in. I see the Math Labs as beginning instruction in this area, and it is unfair to expect the students to be experts. As the quarter dragged on I started to see the writing component of these Math Labs as more and more important. I don't know how to teach these skills other than having them hand in drafts and getting feedback on them, but I think having this happen early in their math major is a very good thing.

One thing I noticed in the first Write-Up draft was that the writings contained a lot of "B.S." Instead of jumping in and getting to the point, students would spend almost a whole page saying vague stuff about why what they were doing was important or fit into some kind of broader (but extremely vague) perspective. My best guess is that this comes from how they are trained to write essays in high school humanities classes. When I handed back these drafts, I gave them a lecture on how mathematical writing should be precise rather than vague, and should try to get to the point as quickly as possible. I included these kinds of comments as instructions for the second round of Write-Ups, and the situation improved somewhat.

Overall, I see the writing component of these Math Labs as sort of like toilet-training. It is miserable by nature, but life is much better because of it.

WARNINGS: The following are various things we have learned so far in the process of figuring out how to do these labs.

- (1) Some students (particularly international students) are very resistant about participating in class. Some will just pull out their phones or work on something entirely different when you want them to be exploring something. Consider having participation points for each day (maybe just 2, say), and make it clear that the points are awarded based on your subjective perception of how much they are participating. Be completely transparent during the first couple of weeks about how many points students are earning (e.g., enter these points into Canvas after every class session) and prepare to be harsh when students argue with you. **Set the tone early on for what acceptable participation is.**
- (2) Along the same lines, some students will do the absolute minimum they can to pass the course. Adopt a point system and a definition of passing so that the "absolute minimum" meets your own standard (see the syllabus below for an example).
- (3) Most likely you will be having students work in groups in these courses. This might be harder than you expect, and it takes some effort to do it well. Consider explaining to the students at the beginning of the quarter (and repeating often) that talking math with other people (and working with other people) is a skill they need to develop, and part of the point of the course.

Consider assigning the groups yourself, and sometimes rearranging the groups. This is hard, especially when students resist! Another approach is to do a weekly

check-in with all students to see if they are satisfied in their group; in cases where someone is not satisfied, make a change. People who take this approach report that usually by week 4 or 5 the groups become very stable.

- (4) The task of reviewing student work can be pretty overwhelming. It is important to give students feedback, and paper markers don't have the skills to do a good job with this kind of course. Be prepared for this by carefully thinking about your course design, and what student work will be reviewed carefully versus perfunctorily.
- (5) Some students probably shouldn't be taking MathLabs because they are already juniors or seniors who have completed several upper-division classes. If you can figure who these people are on day one and encourage them to drop, the class will go better. You can suggest that they contact Hayden or one of the other advisors, to see if their MathLab requirement can be waived.

Sample syllabus on next page.

Note: This is the syllabus I used for MATH 206 in Fall 2018.

MATH 206: Combinatorics MathLab

Syllabus for Fall 2018

Title: Combinatorics MathLab

Instructor: Daniel Dugger

Contact Info: 215 Fenton Hall, 346-8402, ddugger@uoregon.edu (also sometimes available in 205 Fenton Hall inside the main math office)

General information: 2 credits; class meets each Monday and Wednesday from 3–3:50pm in Knight Library B41.

Webpage: <http://pages.uoregon.edu/ddugger/ma206.html>

Prerequisites: None.

Short course description: Exploratory course in mathematics. Course focuses on techniques of mathematical exploration and discovery, the language of mathematics, and foundational issues. Topics from combinatorics.

Long course description: This is a problem-solving course in mathematics, designed to get students started on the path of learning to think like a mathematician. The problems we work on represent a hodgepodge of different kinds, mostly lying in the general area of combinatorics. Some of the skills we will focus on are: trying examples, looking for patterns, making conjectures, testing conjectures, and modifying conjectures. These might sound easy, but when you are reading mathematics you need to be constantly doing all five of these things! It takes practice.

Learning Outcomes: The goal of the MathLabs is to help students make the transition from the kind of “procedure-driven” mathematics that they see in K-12 education (and that to some extent continues in lower-division college courses) to the more creative engagement with mathematics that is required for upper-division math courses.

- Students will continue the development of the mathematical skills of trying examples, looking for patterns, and making/testing/modifying conjectures.
- Students will continue the development of the mathematical skills of explaining their reasoning to others, and in forming judgments regarding whether an explanation is adequate or not.
- Students will continue the development of the skill of critically reading an account of mathematics.
- Students will learn the basics for the LaTeX mathematical typesetting software and be able to use this to produce professional mathematical text.

Class discussions and in-class worksheets, weekly homework, and a final portfolio will provide students with opportunities to demonstrate the level of their abilities relative to the above learning outcomes.

Organization of the course: Each week there are two class sessions, each of which will generally be a combination of discussion and in-class exercises.

Attendance: Attendance is very important in this course. I will take attendance during each class, and this will contribute to your final point count in the course.

Assessment: Points for this course are awarded according to the following scheme:

Attendance	30 (1.5 points per class session)
Weekly writing	20 (two points per week)
Write-up Drafts	24 (eight points each)
Final Portfolio	26 (weekly writings plus four write-ups)

This course is offered as P/N only, with 84 points out of 100 being a passing grade.

Work must be handed in on time, and must be in a reasonable state of completion. Mistakes can always be corrected later in the course. In this course, the only time you will be penalized for “being wrong” is on the final portfolio.

Due dates:

- Weekly writing is due every Monday, at the beginning of class.
- Write-up drafts are due October 10, October 31, and November 20.

The Portfolios will (mostly) be written in LaTeX, which is the main software used for mathematical typesetting. We will learn how to use this software as the course progresses.

NOTE: Late work is not accepted except in extreme circumstances as determined by the instructor.

Workload: A student should expect to spend 60 hours on this course during the term, with the work divided up roughly as follows:

Class sessions	2 hours per week
Reading	1 hour per week
Homework	3 hours per week.

The “Homework” portion of the workload includes three things: weekly writings on the readings, thinking about the exercises, and four “write-ups” that address topics from our exercise sessions. For the latter, you will choose four of the in-class problems we worked on during the quarter and you will give a complete write-up of the solutions. These write-ups should explain the problem, things you tried, any conjectures that arose, and explanations for the conjectures that you know how to resolve. In most cases this will just be a page or two (typewritten) per write-up.

Throughout the course you will maintain a portfolio of your work. The portfolio will contain the things you handed in each week, together with the four write-ups. After getting feedback on your work, you might choose to revise some of it before submitting your final portfolio at the end of the course. This will give you the opportunity to correct mistakes and learn from them, before getting your final grade.

Learning Environment: The University of Oregon strives for inclusive learning environments. Please notify me if the instruction or design of this course results in disability-related barriers to your participation. You are also encouraged to contact the Accessible Education Center in 360 Oregon Hall at 541-346-1155 or uoaec@uoregon.edu.

Academic Conduct: The code of student conduct and community standards is at dos.uoregon.edu/conduct. In this course, it is appropriate to help each other on homework as long as the work you are submitting is your own and you understand it.