

## MCDB 474

### **Independent Research for First-year, Sophomores and Juniors in all majors, and for Seniors who are Non-MCDB Majors: taken as PASS/FAIL**

**Summary:** MCDB 474 is a one-credit research course taken in an authorized laboratory of a Yale University faculty member engaged in research that falls within the disciplines of Molecular, Cellular and Developmental Biology. Students are encouraged to pursue research in the laboratory of a faculty member within the Department of MCDB, or they may pursue a scientific problem in other departments (including at YSM) as long as the research meets certain criteria (described below), or with permission from the course instructors (Joseph Wolenski, Binyam Mogessie and Jacob Musser).

Students who have not declared their major, or who are majoring in any disipline other than MCDB, can enroll in MCDB 474 for up to three terms prior to being a senior. Enrollment in MCDB 474 for more than three terms prior to the senior year requires permission from your residential college Dean. Non-MCDB majors may enroll in MCDB 474 as seniors. By contrast, students who have declared MCDB as their major do not enroll in MCDB 474, but can enroll in one of the following courses for research credit: MCDB 475, 485/586, 495/496.

Students enrolled in MCDB 474 are expected to read and sign the contract (see below), and obtain a signed agreement by the principal investigator (PI) of the lab that will support their research. Please note that research must be under the supervision of a Yale faculty member who is the PI of the laboratory in which you are performing your research. The PI is the faculty member in charge of the lab, and is ultimately responsible for your laboratory project and for monitoring your research progress. You should also specify your lab mentor, who is the person(s) who trains you in laboratory techniques and protocols, and is typically a graduate student, postdoc, or research scientist in the lab. In some instances, a PI may also serve as your laboratory mentor, but in most cases your lab mentor is a distinct person or persons who directly train you in the lab setting.

Prior to the end of the add/drop period, students are expected to meet with their PI and, if possible, their lab mentor, to write a 1-2 page double-spaced, research proposal that describes their research and objectives. The research proposal must be uploaded to the MCDB 474 Assignments section of Canvas by 5 PM on Tuesday January 24, 2023 by 5pm.

A final written report that summarizes your research effort (12-15 pages double spaced) is required to be uploaded to MCDB 474 Canvas Assignments by 5 PM on the last day of classes each term. The 15-page limit is firm and includes: all data, appendices and references. The title page does not count toward the 15-page limit.

Students who successfully complete MCDB 474 receive a P "Pass" on their transcript. No grades are issued. MCDB 474 is one Yale College credit.

MCDB 474 can not be used as a substitute to fulfill the laboratory course research requirements (MCDB 201Lb – MCDB 345Lb) necessary to complete the BA or BS degrees in the MCDB major. MCDB 474 does not fulfill the Senior Requirement for the MCDB BA or BS degrees, nor can it be used as a core requirement for the MCDB major.

All students engaged in MCDB research for Yale College credit must sign and agree to a contract that stipulates the threshold expectations for completion of this one credit course.

## MCDB 474 Student Contract

As a student conducting independent research for Yale College course credit in MCDB 474, I agree to the following:

- 1) My research project will involve on average 12 hours/week of experimentation and analysis in the laboratory setting, with no less than 10 hours per week at any point during the semester when classes are in session. In rare instances where students may not be able to meet the minimal time commitments on a weekly basis, they must make arrangements with their laboratory mentor and laboratory principal investigator (PI) to make-up lost research time prior to the end of the term.
- 2) I acknowledge that failure to be present in the laboratory for the minimal time requirement may result in being removed from MCDB 474 based on the recommendation of the research principal investigator who heads the laboratory, or at the discretion of the MCDB 474 faculty course instructors.
- 3) I will make every effort to attend all of my research PI's laboratory meetings and also present my research to my labmates at least once each term that I'm enrolled in MCDB 474.

Name of student: \_\_\_\_\_

Signature: \_\_\_\_\_

Email address: \_\_\_\_\_

Major: \_\_\_\_\_

College and class: \_\_\_\_\_

Mobile #: \_\_\_\_\_

Name of PI (Faculty who heads the laboratory of your research): \_\_\_\_\_

Department and email of PI: \_\_\_\_\_

Name and title of research mentor if different from PI. This is the person who will work with you at the lab bench on a regular basis. This could be a postdoctoral fellow, a graduate student or a lab manager: \_\_\_\_\_

## MCDB 474 Principal Investigator Contract:

---

One of the requirements for accepting undergraduates into your laboratory for course credit in MCDB 474 research is that you agree to the following:

I acknowledge that each MCDB 474 student engaged in research under my supervision will be present in the laboratory and engaged in the assigned project for 10-12 hours per week on average for the entire term that classes are in session. If this is not the case, by mid semester of the term I will notify the student and the MCDB 474 coordinators that an increase in effort is expected. I am aware that failure to meet this expectation will result in the student's withdrawal from the course. I expect all MCDB 474 students working in my laboratory to attend our laboratory meetings and present their research at least once each term.

Student: \_\_\_\_\_

Research Mentor: \_\_\_\_\_

Signature of Research Mentor: \_\_\_\_\_

Mentor's Department: \_\_\_\_\_

Email Address: \_\_\_\_\_

Mobile #: \_\_\_\_\_

*It is the responsibility of the undergraduate student to obtain the required signatures and upload this form to the MCDB 474 Canvas Assignment section.*

*If you have questions, contact: [Andrea.Chamba@yale.edu](mailto:Andrea.Chamba@yale.edu)*

### **Due dates:**

Fall term of 2023:

Tuesday: 24 January, 2023 by 5 PM to the Canvas Assignments MCDB 474 folder. Student and Mentor Contract; 1–2-page research proposal with 1-3 specific research aims, background, proposed goals and pertinent references.

Friday: 28 April, 2023 by 5 PM to the Canvas Assignments MCDB 474 folder. Fall term final report: (12-15 pages double spaced).

## MCDB 474 – Independent Research (Detailed Information) For Underclassmen & Non-Majors taken as PASS / FAIL

**Course Overview:** The main purpose of this course is to enable you to obtain hands-on experience with basic research as part of your education at Yale. The course entails one semester of experimental work (the minimum time expectation is 10-12 hr/week in the lab) aimed at generating data using experimental strategies designed to address a specific research problem. The course also requires a final written summary in the format of a research paper.

**Submission and Formatting Instructions for All Written Work:** All papers should be uploaded to the Assignment section in Canvas (MCDB 474) by the deadlines stated (this is almost always the last day of classes). For your research proposal due at the end of the add/drop period at the start of the term, you present a 1–2-page paper that you write with guidance and input from your PI and/or mentor that outlines 1-3 specific aims, a short background on the research problem, a succinct description of your primary research methods, and a very brief literature reference list (5-8 references). The primary goal of this proposal is to provide evidence to the MCDB 474 course instructors that you have met with a principal investigator who heads a lab at Yale and discussed a tractable research project with realistic specific aims that fall within the disciplines of molecular, cellular and development biology research. The title page does not count toward the 2-page limit.

For your final research summary paper due on the last day of classes, you submit a 12–15-page research paper (double spaced: 15-page limit maximum, font 12) that summarizes all you have accomplished using a typical journal paper format: 1) title, 2) abstract, 3) materials and methods, 4) results, 5) discussion of data and 6) succinct reference list.

The preferred format style is detailed in the following paper: *How to Write your First Research Paper*. Elena D. Kallestinova. *Yale Journal of Biology and Medicine* 84 (2011), pp 181-190. Yale Graduate School, Graduate Writing Center.

[https://poorvucenter.yale.edu/sites/default/files/files/how to write your first research paper 2011.pdf](https://poorvucenter.yale.edu/sites/default/files/files/how%20to%20write%20your%20first%20research%20paper%202011.pdf)

If you would like more detailed information, please read some of the guidelines outlined by the *Journal of Cell Biology*.

[https://poorvucenter.yale.edu/sites/default/files/files/how to write your first research paper 2011.pdf](https://poorvucenter.yale.edu/sites/default/files/files/how%20to%20write%20your%20first%20research%20paper%202011.pdf)

For both your research proposal paper (due at the end of add/drop period) and summary paper (due on the last day of classes), be sure to include a title page with the following information: (a) Title of Research, (b) Student Name, (c) PI name and names of other laboratory mentors who will provide you with training (other than PI), (e) Course & Term. Make sure to include a header on pages 2 through the end of the document with: (a) Student Name and laboratory PI, (b) Course & Term and (c) Page Number.

Save papers as a pdf using the following nomenclature:

*StudentLastName\_FirstName\_MCDBCOURSE\_Term&Year.pdf*. **Send a copy to your PI**

**Safety Requirements:** You will need to fulfill various safety requirements depending on your field of study. If you will be working with radioisotopes in a laboratory, you must have successfully completed a radiation safety training seminar at Yale. You will not be able to start

your experiments unless this requirement is fulfilled. In addition, you should discuss with your supervisor whether you should take a chemical safety course. For further information on both these topics contact Environmental Health and Safety:

<https://ehs.yale.edu/> Tel. 5-3550.

If your proposed research involves animal use, your professor **must** have an approval for this protocol from IACUC. Your professor must send a new form to IACUC to include you in the protocol once your project has been approved. Finally, if you have not already done so, you need to complete an IACUC course before research can begin.

## Course Requirements:

### Research Proposal, Student and Research Mentor Contracts:

All research proposals and student and mentor contracts are due by 5pm on Tuesday 24 January, 2023 by uploading to the MCDB 474 Assignments section on Canvas.

**Research Proposal:** For the spring term of 2023, the due date is: Tuesday 24 January, 2023 by 5 pm. Extensions may be granted in extenuating circumstances

Writing your proposal: A 1–2-page double-spaced overview of your research plan should be written with the guidance of your mentor and the PI of your laboratory. It should include a ~1 page overview/background of the project with short bibliography, hypothesis to be tested and most importantly, the specific aims of your project. For guidance, ask your mentor to see a Specific Aims section of one of their NIH or NSF grants. The title page does not count toward the 2-page limit. However, the background, specific aims, any preliminary data, references, and any other text must not exceed 2 pages.

To be acceptable for MCDB research credit, the proposal must make clear the following criteria are met.

- 1) Students must be involved in the design of the proposed experiments.
- 2) Students must test at least one specific hypothesis.
- 3) The science must be of general relevance to topics covered in the Department of MCDB.
- 4) The project can involve computational research, as long as the focus involves analysis of a biological problem.

Inappropriate Proposals that are unacceptable for MCDB research credit include lab work dedicated to analyzing data gathered by someone else, or entering previously obtained data into a computer and running a statistical analysis program. Another example of an unsuitable proposal would be gathering data for another person to analyze. For example, taking medical histories or clinical measurements that will be passed on to someone else for study. Reading fMRIs and entering data are rarely acceptable. Projects involving allelic screening of patient populations for SNPs associated with a given disease are also not acceptable unless there is substantive experimental design/content. ***If you are considering a project that may fall into one of the categories above, please discuss this with the instructors in charge of MCDB 474 or the DUS of MCDB prior to committing to that laboratory or project (there may be suitable alternative projects in the same lab).***

**Time Commitment:** We are particularly concerned that each student fulfills the minimum 10-12 hr/week research commitment in the lab; part of the Mentor's Contract is to verify that level of

participation by mid-semester. ***If for any reason you are unable to fulfill your commitment to the course and laboratory, you will be asked to withdraw from the course.***

**Final Report – Research Journal:** Final course papers are due at 5 pm on the last day of classes. Due date for spring term of 2023: 28 April, 2023 by 5:00pm on Canvas Assignments.

A 12–15-page double-spaced report in the form of a typical **Research Journal** uploaded to the Assignment section in Canvas by the above dates. Well in advance of this deadline, you should meet with your research mentor to plan a general outline for your paper and engage them in continued discussions throughout the writing process. You should conform to any other specifics that your mentor might expect in your write-up. The research mentor should grade the final version of the report and return it to us with comments electronically along with a recommendation for an overall course grade. Your research mentor will be contacted directly with grading information near the end of the term.

The report should be written in a style similar to that of a paper in a typical **Research Journal** and should include the following sections:

- *Abstract:* This is a brief summary of the project and the results obtained.
- *Introduction:* What is the biological problem, why is it important, and what's known about it already?
- *Experimental Procedures* (Material and Methods).
- *Results:* Describe what you have done. Include bar graphs, sketches, diagrams, tables, photographs etc.
- *Discussion:* If your project was successful, describe the significance of the results. If your project did not work, describe what you think went wrong, and what your expectations were. Regardless of the outcome, describe what you would try next if you were to continue the project.
- *References:* References to previous work discussed as well as methods used should be cited as in any other research paper.

**Grading:** All students taking this course will receive **Pass/Fail**. Independent study courses earn Yale College credit for Underclassmen, but are governed by the new “P/F with report” policy. A student who passes this course will have the mark of “P” entered on the Yale College transcript once the course instructor submits an independent study report form that describes the nature of the course and provides a detailed evaluation of the student’s performance in it. Failures in the course will result in the recording of an “F”.