

MCDB 485/486 Student Contract

Undergraduate research opportunities in the biological sciences are available to all Yale students. The first step in this process is to select a laboratory whose research projects align with your interests, and ideally complements your research passion. Here in the Department of MCDB, one of our goals is to foster creative independent research opportunities for undergraduates while also providing students with exposure to a broad range of pertinent topics in the life sciences. For those students who elect to participate in year-long independent research for Yale College course credit and to fulfill the Senior requirement for the MCDB BS, a research agreement signed by both the student and faculty mentor (i.e., the Principal Investigator of the laboratory in which you propose to perform research) is required. This signed contract is due in the Office of the MCDB DUS by 5 PM on the last day of the course selection period. Signed contracts are submitted by uploading to the MCDB 485/486 Canvas Assignment folder.

As an MCDB student conducting two-terms of independent research for Yale College course credit in MCDB 485/486, I agree to the following:

1. My research project will involve >10 hours per 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 are unable to meet the minimal time commitments, they must make arrangements with their PI and mentor (typically a graduate student or postdoc), 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 485/486 based on the recommendation of the research principal investigator who heads the laboratory, or at the discretion of the MCDB 485/486 faculty course instructors.
3. I will make every effort to attend all the meetings scheduled for my research laboratory group to discuss my results and contribute to the laboratory research goals. I will also present my research to my lab group at least once each term that I'm enrolled in MCDB 485/486.
4. I will give a 12-minute formal seminar (MCDB 485/486 oral presentation requirement). This oral presentation may be similar in content to the seminar presented at your laboratory group meeting (see #3), but is different in that it is presented to a cohort of peers enrolled in the MCDB 485/486 research courses.
5. I will attend at least 2 of the MCDB 485/486 oral presentation sessions and will present my research at one of them.
6. I will make every effort to schedule my MCDB Oral Presentations at the time that fits with my mentor's schedule so that my mentor and laboratory colleagues can attend my talk.
7. I will present a printed poster at the MCDB Undergraduate Research Poster Symposium on the final day of classes of the Spring term.

Due dates: Student and Mentor Contract and a 1 Page Research Proposal (MCDB 485 only):

Fall: TUESDAY, SEPTEMBER 5, 2023 @ 5:00 PM

Spring: FRIDAY, JANUARY 19, 2024 @ 5:00 PM

Final Report Due:

Fall: FRIDAY, DECEMBER 8, 2023 @ 5:00 PM

Spring: FRIDAY, APRIL 26, 2024 @ 5:00 PM

Student Name: _____ Signature: _____

Email Address: _____ Class of: _____

Research Mentor (Faculty only): _____

Title of Research Project: _____

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:

Name of mentor: _____ Title: _____

MCDB 485 Research Mentor Contract

As the Principal Investigator of Laboratory:

- I acknowledge that any MCDB 485/486 student in my laboratory is expected to complete an average of at least 10-12 hours of effort per week in the lab for each term. If my undergraduate MCDB student is not able to meet this laboratory requirement, by mid semester of the term I will notify the student and the MCDB 485/486 course instructors/Office of the DUS (Joseph.Wolenski@yale.edu, andrea.chamba@yale.edu) 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 MCDB 485/486 students working in my laboratory to attend our scheduled laboratory meetings and present their research at least once each term to provide guidance, constructive feedback, evaluate their progress and establish a basis for their MCDB 485/486 grade.
- I will read and grade my student's final paper and submit a suggested letter grade to andrea.chamba@yale.edu by the due date assigned for grades.
- As a PI mentoring this undergraduate student, I will make every effort to attend my student's MCDB Oral Presentation. If I am unable to attend, I will ask my student to establish a remote video link (e.g., Zoom). Other lab members are encouraged to attend the undergraduate student seminar and poster session.
- I (or the lab mentor supervising the undergraduate student), will assist the student in the design, content, and printing of their poster for the MCDB Undergraduate Poster Symposium held on the last day of classes of the Spring term.

Student: _____

Research Mentor (Faculty only): _____

Signature of Research Mentor (Faculty only): _____

Mentor's Department: _____

Email Address: _____

It is the responsibility of the undergraduate student to obtain the required signatures and upload this form to the MCDB 485/486 Canvas Assignment section. If you have questions, contact andrea.chamba@yale.edu

MCDB 485/486

Independent Research to satisfy the MCDB BS Major Senior Requirement

Summary: MCDB 485 and 486 are one-credit research courses taken consecutively during the senior year (2-credits total). Students receive a grade of Satisfactory or Unsatisfactory in the fall term for MCDB 485. At the end of the spring term a Satisfactory grade in MCDB 485 is reassigned as a letter grade on your transcripts, and MCDB 486 is also given a letter grade that will be on your senior year transcripts. In rare instances where students receive a grade of Unsatisfactory in MCDB 485, they will not be permitted to enroll in MCDB 486. If students are unable to complete the requirements of MCDB 485, they may be able to continue research by enrolling in MCDB 475 after consulting with the course director and/or DUS, but enrollment in an additional MCDB course 350+ (non-laboratory) is a more suitable alternative for the MCDB BA degree.

MCDB 485 is taken in the fall term followed by MCDB 486 in the spring term. The research project must fall within the disciplines of Molecular, Cellular and Developmental Biology. Students are strongly encouraged to seek out a supportive faculty member within the Department of MCDB early in their academic career, and no later than the summer preceding the start of their senior year, to secure a laboratory position for a full year of senior research. A few students begin research during their sophomore or junior years enrolled in MCDB 475, and continue in the same lab as seniors enrolled in MCDB 485/486. Do not wait until the first week of classes during the fall term of your senior year to find a lab in which to work. Pursuing a research project in a laboratory outside the Department of MCDB is acceptable, as long as the project meets criteria outlined below. Research within a laboratory at the YSM is acceptable, as long as the student is involved in experimental design and the project is not based solely on analysis of data from work of others. Computational analysis, molecular modelling and simulations are acceptable as long as the student proposes to model data they had a hand in generating. If a student is interested in research that does not have a substantial biomedical focus, or if the proposed research involves only analysis of data collected by others, this project may not be suitable for MCDB 485/486 credit. If your project is not typically considered to be within the disciplines of molecular, cellular and developmental biology, please contact the course instructors via the office of the MCDB DUS (andrea.chamba@yale.edu) prior to making any firm commitments to work in a lab.

MCDB 485/486 research courses are for students committed to a full year of consecutive research during their senior year. If you are unsure about how things will work in a new laboratory, or if you can't commit to a full senior year of uninterrupted research, please consider enrolling in MCDB 475 independent research. MCDB 475 is a one credit independent research class for seniors that can be taken in the fall and/or spring terms. Any senior who completes only one term of research will be credited with enrollment in MCDB 475. For example, students who have completed MCDB 485 but are unable to enroll or successfully complete MCDB 486 will have their course transcripts changed to reflect enrollment in one term of MCDB 475.

Do not enroll in MCDB 485/486 unless you are sincere about a full year of senior research, and you have a faculty PI who is supportive. If you have any doubt about your ability to work in a lab for a full year, enroll in MCDB 475 and see how one term of research fits into your schedule. If the lab chemistry is good, and your progress at the lab bench is satisfactory, you can continue to a second term of MCDB 475 as a senior and still earn a MCDB BS degree (assuming all necessary course work is completed).

MCDB 485/486 cannot be used as a substitute to fulfill the required laboratory courses (i.e., the lab classes MCDB 201Lb – MCDB 345Lb) necessary to complete the BA or BS degrees in the MCDB major.

Sequence of enrollment: Students enroll in MCDB 485 in the fall term of their senior year followed by enrollment of MCDB 486 in the spring term of their senior year. In cases where students have taken a leave of absence and their degree sequence is delayed by one term it is possible to enroll in MCDB 485 in the spring of their penultimate term followed by enrollment in MCDB 486 in the fall of their final term at Yale. In these rare instances, students enrolled out-of-sequence in MCDB 485/486 must still submit a poster summarizing their senior research due on the last day of classes in the spring term. Students who graduate in December and are unable to physically present their poster on the last day of classes in April, may submit posters electronically and ask a lab mate or classmate to step in a set up their poster at the poster session.

Students enrolled in MCDB 486 out-of-sequence are still required to give a formal 12-minute seminar to a peer cohort of undergraduates and the course director in their final term (early December).

No Proposal necessary for MCDB 486. If you completed MCDB 485 in the fall term of your senior year and are starting MCDB 496 without any gaps in your enrollment, you do not need to write another proposal for MCDB 486 in the spring term, as long as you are continuing on the same project in the same lab as in MCDB 485.

Unacceptable Research Proposals: Students are encouraged to pursue research on topics pertinent to the interests of the Department of MCDB. This includes a broad range of biomedical research topics ranging from chemical biology to molecular modeling and even statistical software development. Some proposals are not accepted for MCDB credit since the research falls outside our broad field of interests. Proposals will be rejected if a student intends to dedicate the bulk of their time analyzing data gathered by someone else, or if they will be 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 unless the student is involved in the design of the experiment or is developing new computational programs to better analyze the data. 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 instructor(s) in charge prior to committing to that laboratory for a research project, (there may be suitable alternative projects in the same lab, or you may need to switch labs).*

Time Commitment: We will closely monitor research effort to confirm each student fulfills the minimum of 10-12 hours/week in the lab engaged in productive research. Note that your mentor's contract requires confirmation of that level of participation by midsemester. **If for any reason you are unable to fulfill your commitment to the MCDB 485/486 research course, you will be asked to withdraw from MCDB 485/486 and your course affiliation and credit will be converted to MCDB 475 if you decide not to continue in the spring term with further research.** Note, if you are planning on attending multiple interviews for medical school in the fall term, you are expected to make up for lost time.

ASSIGNMENTS DEADLINE for MCDB 485:

1. Student and Mentor Contract: TUESDAY, SEPTEMBER 5, 2023 @ 5:00 PM
2. Research Proposal: TUESDAY, SEPTEMBER 5, 2023 @ 5:00 PM
3. Fall Grant Proposal Report: FRIDAY, DECEMBER 8, 2023 @ 5:00 PM

Student and Mentor Contract: to be signed by the PI of the lab (must be a Yale faculty member, not a graduate student mentor) contracts are attached to this document.

Upload to Canvas MCDB 485 Assignments folder.

Research Proposal: 1–2-page research proposal (double spaced) with 1-3 specific research aims, background, proposed goals and pertinent references. Proposal is limited to 2-pages (title page is not included in the 2 page limit).

Upload to Canvas MCDB 485 Assignments folder.

Students submit a Research Proposal at the start of the fall term. Students enrolled in MCDB 485/486 are expected to meet with their faculty principal investigator (and mentor if possible) to draft a 1-2-page research proposal (double spaced). Ideally you can meet prior to the start of your senior year, but if this is not the case, students must meet (this can be via Zoom) during the first week of classes to finalize a research proposal that is mutually satisfactory. The 2-page limit proposal include specific aims, background, rationale and limited references. This should include a short (no more than 1 page) overview/background of the project and a section describing the general objectives, and most importantly, the specific aims of your project. You do not need to include Results/Figures in your research proposal. For guidance, ask your mentor to see a Specific Aims section of one of her/his NIH or NSF grants. The Background, Specific Aims and Methods section of your proposal should not exceed two pages double spaced. The title page is not counted in the two-page limit. The course directors read these proposals with the goal of assessing whether the specific aims are realistic and practical, and more importantly, if the MCDB student is likely to learn bench techniques and scientific methods pertinent to research in biological science.

Grant Proposal Report: To receive credit for MCDB 485, students must submit a 5-page (double-spaced) grant proposal due on the last day of classes (FRIDAY, DECEMBER 8, 2023 @ 5:00 PM). This page limit is for the entire report— including everything but the title page. To be clear: you have a title page with your name, the name of your PI, the name of your mentor (if different from your PI), course #, and the title of your research. The next five pages include the following sections:

General Objectives (very brief statement)

Specific Aims

Background and Significance

Preliminary Results

Research Plan

Bibliography

Figure legends must have captions that describe the contents of each figure

Ergo, your final report has 1 title page and 5 pages (maximum) of research.

ASSIGNMENTS DEADLINE for MCDB 486:

1. Oral Presentations: TBA – early December
2. Research Journal Report: FRIDAY, DECEMBER 8, 2023 @ 5:00 PM (last day of classes)
3. Poster Symposium: FRIDAY, DECEMBER 8, 2023 @ 5:00 PM Posters due via electronic upload to CANVAS. **Likely 48 hours prior to the last day of classes.**

MCDB Oral Presentations: Upload presentation to Canvas MCB 486 Assignments Folder. Students give a **12-minute formal seminar** to a peer cohort in early April. This seminar is limited to 15 minutes to allow for a few questions from the audience. Each student will give an oral presentation on their research to a small group of students enrolled in MCDB 485/486. These sessions will also be open to faculty mentors and lab colleagues. Following the 12-minute presentation, students are expected to answer 2-3 questions from the peer group and faculty. Questions from peers are strongly encouraged and a portion of your course grade will be based in part on participation in these sessions. There will be 6-7 students presenting at each of the sessions, which generally run for about 2+ hours. Students must present at one session and attend one additional small group session as a member of the supporting cohort. These presentations should be made using PowerPoint. We will have a digital projector available; however, you should plan on bringing your own laptop and adaptors to plug into the HDMI system.

All students in the MCDB 485/486 courses are expected to attend a minimum of 2 MCDB Oral Presentation sessions (i.e., you will present at one session and attend one additional session for a total of 2 sessions). Signups will be handled through a google doc by the MCDB Registrar. Attendance will be taken at the seminars. Failure to attend the two required sessions will result in a loss of a half grade (e.g., a final grade of A- will be lowered to a B+). Students should try to find a mutually agreeable time with their research mentors and Principal investigators, so they are able to attend your 12-minute oral presentation. Each student must have a verified time slot for his/her presentation (using the google doc sign-up schedule).

Individual slides should be simple and not overloaded with text. Many skilled presenters find it effective to present only one key idea on each slide, as a general rule, and to provide a title on each slide. Your talk should include an introduction of the overarching biological question that you addressed, an explanation of the approach you took to tackle this question, your results, and the conclusions. Your objective should be to make your presentation clear and interesting to individuals who do not share your research background. It is extremely important to define any technical terms and acronyms. You should assume that the audience does not know the terminology or background of your field.

Give a practice talk to your lab members before you give it to the MCDB 495/496 class. As noted in the Research Mentor's contract, his/her attendance at the session at which you are presenting is expected; if she/he cannot attend, you should arrange for someone else from your lab to attend. You can also set up a Zoom remote video session so your mentor can participate if they are unable to attend. Mentor participation is a critical aspect of the course. Consequently, consult your research mentor at the beginning of the term to select a date that fits with her/his schedule.

Research Journal Report: Students submit a **12-15 (double-spaced) research journal report** due on the last day of classes in April. This written report should summarize your research effort. The 15-page limit

is firm and includes: all data, appendices and references. The title page does not count toward the 15-page limit.

Well in advance of this deadline, you should meet with your research mentor to plan a general outline for your paper. You and your mentor should engage in continued discussions throughout the writing process. The lab PI should grade the final version of the report and return it to the Office of the DUS (andrea.chamba@yale.edu) with comments, along with a recommendation for an overall course grade. Your research mentor will be contacted directly by the MCDB DUS with a student evaluation form used for grading 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 (*Journal of Cell Biology*) and should include the following sections:

- Title Page: Including title, the name and department of the faculty member in whose laboratory the project was performed, the name of the student, course number and date.
- 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 and Figure Legends: Describe what you have done. Include bar graphs, sketches, diagrams, tables, photographs etc. -- whatever is needed to represent your data. Figure Legends include captions that describe the contents of each figure.
- 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 outcome, describe what you would try next if you were to continue the project.
- References: (literature cited) References to previous work mentioned in your paper, as well as methods used, should be cited as in any other research paper. Each reference must be listed in the order of its appearance in the text and include title, authors, journal name, volume, year and page numbers.
- 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)

For 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)

Spring Poster Symposium: The purpose of the MCDB 485/486 poster symposium is to share information and more specifically to highlight undergraduate research at Yale. This symposium will be held in YSB. The symposium will be open to anyone wishing to attend, so please encourage friends, colleagues, and other students to visit you on this special day. Your research mentor is strongly urged to attend. Each student must prepare a poster. Posters can be as large as 4' X 6' but may be smaller. We will have poster boards and easels available for you to mount your poster. Posters may be printed professionally (please note that there is no funding available for this expense from MCDB), or the student may print them on a printer and assemble individual sheets onto the poster board at the poster session. Please do not wait until the 11th hour to print your poster since local printers may not be able to meet your deadline. Posters should have

a title, and the authors (including you, your PI, and your research mentor) should be listed as well, usually in large letters at the top, and your research course #. The poster should include three sections: Introduction, Results, and Conclusions. The Introduction explains the purpose of your project; the Results section contains figures and/or tables showing your data, with legends or commentary; the Conclusion summarizes what you learned. Feel free to include what you would do next if you were to continue working on the project.

If you continue in research, the first presentation you are likely to give at a scientific meeting is a poster, so this will be good practice. The fewer the words and the LARGER THEY ARE WRITTEN make it easier for people to notice and examine your poster. If a poster contains a great deal of text in small font, the audience may not stop and read your work. The same applies to data. Tables with large numbers of entries may be ignored. Simple figures with a concise conclusion for each are optimal. You should begin to organize your poster well in advance (plan at least one week to assemble the entire project) and if you are outsourcing the print job, plan on several days for the poster print job to be completed. Bring it to the poster session ready to assemble. Please keep in mind that content should take precedence over form. It is most important that your poster be clear, informative, and include meaningful data. Aesthetic appeal is nice, but the science is paramount. Finally, discuss your presentation with your colleagues, PI and research mentor well before the session and if you have any further questions/concerns, bring the preliminary poster to show the MCDB 485/486 course instructors.

ADDITIONAL GUIDELINES:

Submission and Formatting Instructions for all written work: All papers should be uploaded to the *Assignments* folder in Yale Canvas for MCDB 485/486. Additionally, please follow these formatting instructions: include a title page with the following information:

- (a) Title of Research,
- (b) Student Name,
- (c) Course # & Term, and
- (d) PI Name.
- (e) Include a header on pages 2 through end with: Student Name, course & Term and page number.

Save papers as a pdf using the following nomenclature:

StudentLastName_FirstName_MCDBCourse_Term&Year.pdf.

Always send a copy to your PI and upload to Canvas!

Safety Requirements: You will need to fulfill certain safety requirements prior to starting research that vary depending on your field of study. If you will be working with radioisotopes in a laboratory you must have attended 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. If your proposed research involves animal use your professor must have approval for the protocol from the Yale Institutional Animal Care & Use Committee (IACUC). Your professor must send a new form to IACUC to include you in the protocol once your project has been approved. If you have not already done so, you may need to complete an IACUC course before research can begin.

Students enrolled in MCDB 485/486 are expected to read and sign a binding contract (see below) that indicates your willingness to meet essential criteria for a year of research in a chosen laboratory. The

contract signed by you and your principal investigator (or mentor) is required to be uploaded to MCDB 485/486 Canvas Assignments folder by 5:00PM on the date assigned above for MCDB 485/486.

Grading: The final grade will be based primarily on the recommendations from your research mentor on the level and quality of effort in the laboratory, your seminars, oral presentation to the peer cohort, poster and the quality of the final research reports. The MCDB research coordinators retains final grade determination if the recommended grade is at variance with the overall quality/scope of the performance of other course participants. A final grade deduction will be taken if a student fails to attend at least two MCDB Oral Presentation sessions. Failure to attend the two sessions will result in a loss of a half grade (e.g. a recommended A- will be lowered to a B+). Your mentor will be asked to recommend an interim grade of satisfactory (S) or unsatisfactory (U) at the end of the Fall term based on your laboratory effort and research proposal. Students receiving an unsatisfactory grade will be asked to meet with the instructor in charge and the mentor to identify problems and outline strategies for improvement. In the Spring semester, students will receive a letter grade that will be retroactively applied to the Fall term.

Students receive a grade of Satisfactory or Unsatisfactory for their effort in the fall term for MCDB 485. At the end of the spring term a Satisfactory grade in MCDB 485 is reassigned as a letter grade on your transcripts, and MCDB 496 is also given a letter grade that will be on your senior year transcripts. In rare instances where students receive a grade of Unsatisfactory in MCDB 485, they will not be permitted to continue to MCDB 486.

Addendum - Molecular, Cellular & Developmental Biology

The Senior Requirement

In addition to the course work described on previous pages, all majors in Yale College must satisfy a senior requirement. In MCDB, this can be accomplished in one of several ways, depending on whether the student is a candidate for a BA, BS, BS INT, or BS/MS degree. *The senior requirement must be done during the senior year.*

The BA Degree [0 (senior essay) or 1 (MCDB 475) credit]

The requirement can be met in either of two ways: by submitting a senior essay of 15-20 pages evaluating current research in a field of biology; or by successful completion of one credit of Senior Independent Research (MCDB 475a or b).

A senior choosing to fulfill the requirement with a senior essay must consult with a faculty advisor on the scope and literature of the topic and submit their written approval to the office of the director of undergraduate studies at least one month before the paper is due in the student's last term. The senior essay may be related to the subject matter of a course, but the essay is a separate departmental requirement in addition to any work done in a course. It does not count toward the grade in any course. The senior essay must be completed and submitted via email to andrea.chamba@yale.edu at the office of the director of undergraduate studies by the last day of classes. Students electing this option should obtain an approval form from the office of the director of undergraduate studies.

The BS Degree [2 (MCDB 485 & 486) or 2 (MCDB 475 & 475) credits]

The BS differs from the BA in its greater emphasis on individual research. The senior requirement for the standard BS is two contiguous terms of Senior Research: MCDB 485a/486b. However, students may take 2 contiguous terms of MCDB 475, at least one of which must be taken during the senior year. Ordinarily both terms of Research will be taken during the senior year, but it is possible for a student to begin work toward the senior requirement in the spring of the junior year by taking MCDB 475b, continue the research over the summer, and complete it during the fall of the senior year by taking MCDB 475a – which must be pre-approved by the DUS. Yale College does not grant academic credit for summer research unless the student is enrolled in an independent research course in Yale Summer Session.

The BS INT Degree [4 (MCDB 495 & 496) credits]

For the MCDB BS Intensive major, students fulfill the senior requirement by taking MCDB 495a/496b, Senior Research Intensive, for four credits during their senior year.

The Combined BS/MS Degree Program

Because of the additional and substantial requirements associated with thesis work in the third and fourth years, there is no Senior Requirement *per se*.

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The Senior Requirement – Some Special Options During Covid-19 Pandemic

We hope that seniors will be able to complete their senior research as originally outlined above. However, should it not be possible to complete the research requirements, we are making the following substitutions possible to count towards senior requirements. If it becomes necessary to move away from in-person research, those enrolled in senior research courses will be transitioned to MCDB 470/471-style tutorials or other arrangements made with their lab with permission of the DUS, while remaining enrolled in the original course number.

The BA Degree [0 (senior essay) or 1 (MCDB 475) credit or 1 (MCDB 350+) credit or 1 (MCDB 470) credit or 1 (MCDB 471) credit]

- A) A course MCDB 350 or higher may be substituted for MCDB 475. This is in addition to the regular requirement for an MCDB 350+.
- B) MCDB 470 or MCDB 471 may be substituted for MCDB 475.
- C) The senior essay option remains an option instead of either of these.

The BS Degree [2 (MCDB 485 & 486) or 2 (MCDB 475 & 475) or 2 (MCDB 350+/MCDB 470/471) credits]

- A) During the pandemic, the two independent research courses MCDB 485/486 or MCDB 475 can be replaced by MCDB courses numbered at or above 350. These are in addition to the regular major requirement of one MCDB 350+ course.
- B) The research courses may also be replaced by the new MCDB 470 or MCDB 471 courses. These can replace one or both terms.

The BS INT Degree [4 (MCDB 495 & 496) credits or 4 credits from MCDB350+/470/471]

Given the research-intensive nature of this degree, the best option is to fulfill the Senior Requirement with 4 credits of independent research. We will, however, allow the substitution of any combination of 4 MCDB courses numbered at or above 350 or the new MCDB 470 or 471 courses. *Any of the options other than the 4 credits of independent research will require the permission of the DUS.*

The MCDB 350+ courses in this option are in addition to the regular major requirement of one MCDB 350+ course.

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MCDB 470 – Tutorial in MCDB

Offered fall and spring. Individual or small-group study for qualified students who wish to investigate an area of experimental biology not presently covered by regular courses. A student must secure the sponsorship of a Yale faculty member, who sets the specific requirements. The course will include one or more written works and is expected to meet at least once per week. *It will require the submission of a brief course description, a syllabus, and a reading list to and permission from the DUS at the beginning of the term.*

This course may be taken only by seniors and can be used only to satisfy the Senior Requirement in MCDB.

MCDB 471 – Senior Seminar in Biology

This course instructs students in developing effective writing and speaking skills required for preparation of scientific manuscripts and presentations and communicating in the scientific world. Students will be required to prepare and present oral presentations and to submit a literature review and written grant proposal by the end of the semester. This course may be taken only by seniors and can be used only to satisfy the Senior Requirement in MCDB.