

MCDB 495/496 Student Contract:

Updated for September 2022 to April 2023 academic year.

In the Department of MCDB at Yale, our mission 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 Intensive degree, a research agreement signed by both the student and faculty mentor (i.e., the Principal Investigator (PI) 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 495/496 Canvas Assignment folder.

As an MCDB student conducting independent research for Yale College course credit in MCDB 495/496, I agree to the following:

- 1) My research project will involve >20 hours per week of experimentation and analysis in the laboratory setting, with no less than 20 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 495/496 based on the recommendation of the research principal investigator who heads the laboratory, or at the discretion of the MCDB 495/496 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 495/496.
- 4) I will give a 12-minute formal seminar (MCDB 495/496 oral presentation requirement) in December of 2022. This oral presentation may be similar in content to the seminar presented at your laboratory meeting (see #3), but is different in that it is presented to a cohort of peers enrolled in the MCDB 495/496 research program.
- 5) I will attend at least 2 of the MCDB 495/496 oral presentation sessions and present my research at one.
- 6) I will make every effort to schedule my MCDB Oral Presentations (in December) at the date and time that fits with my mentor's schedule so that my principal investigator and laboratory colleagues can attend my talk.
- 7) I will print and present a poster at the MCDB Undergraduate Research Poster Symposium on my final day of classes in April of 2023.

Due dates: Student and Mentor Contract and a 1 Page Research Proposal (MCDB 495 only):

Fall: FRIDAY, SEPTEMBER 9, 2022 @ 5:00 PM

Spring: TUESDAY, JANUARY 24, 2023 @ 5:00 PM

Final Report Due:

Fall: FRIDAY, DECEMBER 9, 2022 @ 5:00 PM

Spring: FRIDAY, APRIL 28, 2023 @ 5:00 PM

Name: _____

Signature: _____

Phone: _____ Class: _____ Email Address: _____

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: _____

Email address of mentor: _____

MCDB 495/496 Research Mentor Contract

One of the requirements for accepting undergraduates into your laboratory for course credit in MCDB 495/496 research is that you agree to the following:

- I acknowledge that each MCDB 495/496 student engaged in research under my supervision will be present in the laboratory and engaged in the assigned project for >20 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 495/496 coordinators (Joseph.Wolenski@yale.edu, binyam.mogessie@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 all MCDB 495/496 students working in my laboratory to attend our laboratory meetings and present their research at least once each term.
- 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.
- I will assist my student in the design, content and printing of their final poster for the MCDB Undergraduate Poster Symposium held on the last day of classes in Spring 2023.

Student: _____

Research Mentor (faculty only): _____

Signature of Research Mentor (faculty only): _____

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 495/496 Canvas Assignment section.

If you have questions, contact andrea.chamba@yale.edu

MCDB 495/496

Independent Research to satisfy the MCDB BS Intensive Major Senior Requirement

Summary: MCDB 495 and MCDB 496 are two-credit research courses taken consecutively during the senior year (4-credits total). The main purpose of this two-term research program is to enable undergraduates to learn how to design biological research experiments and obtain extensive hands-on laboratory research training while at Yale. MCDB 495/496 entails a full year of senior experimental research with a minimum time expectation of 20 hours per week (on average) at the lab bench. To be productive in this lab environment, students often find they need to dedicate more time at the bench than initially anticipated. Successful students often work much more than 20 hours per week in the lab, with some students averaging closer to 40 hours per week when time permits and during fall and spring recess periods. Students should consider enrolling in MCDB 495/496 only if you are able to dedicate a significant amount of each week to being in a lab for the entire senior year. If you are planning on leaving campus frequently for interviews and cannot meet the minimum time requirement, enroll in MCDB 485/486—which requires a minimum of 10-12 hours per week in the lab. If you are unsure about your ability to make research progress in a new laboratory, or if you can't commit to a full senior year of uninterrupted intensive research, 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 and provides the best option for a student who would like to switch labs after one term.

Students enrolled in MCDB 495/496 independent research must be involved in the design of their proposed experiments as well as the development of specific aims that guide your research. The proposed research must test a hypothesis, and it is imperative that students find a suitable principal investigator who can provide regular feedback and support for the entire year. The area of research can be broad but must be relevant to topics of interest to the Department 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 the YSM) if the research meets certain criteria (described below), or with permission from the course instructors. Computational analysis, molecular modelling and simulations are acceptable as long as the student proposes to develop models based on experimental data they generated. If a student is interested in research that does not have a substantial biomedical focus, or if the proposed research is primarily analysis of data collected by others (e.g., analysis of MRIs), this project may not be suitable for MCDB 495/496 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 particular lab.

Only MCDB seniors may take this course, and only to fulfill the Senior Requirement for the MCDB BS Intensive degree. MCDB 495/496 cannot 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.

Sequence of enrollment: Students enroll in MCDB 495 in the fall term of their senior year followed by enrollment of MCDB 496 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 (this is often due to COVID safety concerns) it is possible to enroll in MCDB 495 in the spring of their penultimate term followed by enrollment in MCDB 496 in the fall of their final term at Yale. **We do not anticipate this to be an issue for the academic year given that the university is expecting all students to return for in-person instruction starting in the fall of 2022.** In rare instances where a student chooses to enroll in MCDB 495/496 out of sequence they must still submit a poster summarizing their senior research due on the last day of classes in their final term. Students who graduate in December may submit posters electronically for the presentation in April. Students who graduate in December do not need to be physically on campus to present the final MCDB 495/496 poster session in April.

Students who are enrolled out-of-sequence must also present to a peer cohort a formal 15-minute seminar in their MCDB 495 term.

No Proposal necessary for MCDB 496. If you completed MCDB 495 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 496 in the spring term, as long as you are continuing on the same project in the same lab as in MCDB 495. If you switch labs (this is rare), please notify the DUS.

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. 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 20 hours/week in the lab engaged in productive research. Note that your mentor's contract requires confirmation of that level of participation by mid-semester. **If for any reason you are unable to fulfill your commitment to the MCDB 495/496 research course, you will be asked to withdraw from MCDB 495/496 and your course affiliation and credit will be converted to MCDB 485 (or 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, you are expected to make up for lost time.

ASSIGNMENTS:

2022 MCDB 495 - Fall Term:

Deadlines for assignments:

1. Student and Mentor Contract: September 9, 2022
2. Research Proposal: September 9, 2022
3. Oral Presentations: TBD – likely mid December 2022
4. Fall Grant Proposal Report: December 9, 2022

Student and Mentor Contract: to be signed by the PI of the lab (faculty only) contracts are attached to this document.

DUE: Friday, September 9, 2022 @ 5:00 PM – Upload to Canvas MCDB 495 Assignments folder.

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

DUE: Friday, September 9, 2022 @ 5:00 PM – Upload to Canvas MCDB 495 Assignments folder.

Students submit a Research Proposal at the start of the fall term. Students enrolled in MCDB 495/496 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. The title page is not counted in the two-page limit.

Oral Presentations:

DUE: TBA – likely early December – upload presentation to Canvas MCB 495 Assignments Folder.

Students give a **12-minute formal seminar** to a peer cohort in early December. Each presentation 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 consisting of other students enrolled in MCDB 495/496. These sessions will also be open to faculty mentors and lab colleagues of the speakers. Following the 12-minute presentation, students are expected to answer 2-3 questions from the peer group and faculty and course instructors. 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 a seminar at one session and attend one additional seminar session to support their peers. These presentations should be made using PowerPoint. We will provide a digital projector or flat panel display for the seminars; however, you should plan on bringing your own laptop to plug into the system. Students should also have an adapter for HDMI connections.

All students in the MCDB 495/496 courses are expected to attend a minimum of 2 MCDB Oral Presentation sessions in the Fall term, (i.e., you will present at one session and attend 1 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, 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 remote broadcast (e.g., Zoom) of your talk if your PI is out of town. Mentor participation is a critical aspect of the course, so consult your research mentor at the beginning of the term to select a date that fits with her/his schedule.

Fall Grant Proposal Report:

DUE: Friday December 9, 2022 – Upload to Canvas MCDB 495 Assignments folder.

Students submit a **grant proposal** at the end of the fall term. To receive credit for MCDB 495, students must submit a 5-10 page (double-spaced) grant proposal due on the last day of classes in the fall term. This page limit is for the entire report— including figures and references. Do not exceed 12 pages total. Make sure you have the following sections, which are patterned after the format of an NIH or NSF Grant:

- 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

2023 MCDB 496 - Spring Term:

Deadlines for assignments:

1. Research Journal Report: April 28, 2023 (last day of classes)
2. Poster Symposium: April 28, 2023 2:00-4:00PM in YSB Lobby.
Posters due via electronic upload to CANVAS. **Likely 48 hours prior to the last day of classes.**

**If you completed MCDB 495 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 496 in the spring term.*

Research Journal Report:

Students submit a **15-20 (double-spaced) research report** due on the last day of classes in April. This written report should summarize your research effort. The 15-20 page limit is firm and includes: all data, appendices and references. The title page does not count toward the 15-20 page limit. The research mentor should grade the final version of the report and return it to the Office of the DUS (andrea.chamba@yale.edu) with comments electronically, along with a recommendation for an overall course grade. Your research mentor will be contacted directly with a form for grading near the end of the term. Consult your research mentor with any further questions that you might have. You should conform to any other specifics that your research mentor might expect in your write-up. 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)

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)

Spring Poster Symposium:

DUE: April 28, 2023 from 2:00-4:00PM IN YSB Lobby – upload to Canvas by 5:00 PM April 26, 2023

The purpose of the MCDB 495/496 poster symposium is to share information and highlight undergraduate research at Yale. This symposium will be held in YSB or remotely pending health requirements due to COVID-19. The symposium will be open to anyone wishing to attend, so please encourage friends, colleagues and other students to attend. 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 color 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 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 also to include what you would do next if you were to continue working on the project. If you are unable to obtain financial support from your PI to pay for the cost of a color poster, just print your figures and tables on several pages of paper using a standard monochrome laser printer. No worries. We are interested in your understanding of the data and the significance of your research, not the optics of your poster.

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 read it. 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 of the due date (plan on at least a week to get it completed) and if you are outsourcing the print job, plan on several days for the project to be printed. 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 of course nice, but the science is paramount. Finally, discuss your presentation with your colleagues and research mentor well before the session and if you have any further questions/concerns bring the preliminary poster to show the instructor in charge.

ADDITIONAL GUIDELINES:

Submission and Formatting Instructions for all written work: All papers should be uploaded to the *Assignments* folder in Yale Canvas for MCDB 495/496. 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. **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 495/496 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 – faculty only) is required to be uploaded to MCDB 495/496 Canvas Assignments folder by 5 PM September 9, 2022.

Grading: The final grade will be based in part on the recommendations from your PI, your research mentor, the level and quality of effort in the laboratory, your seminars in your laboratory, seminar presentation to the peer cohort, poster presentation, and the quality of the final research reports. The MCDB research coordinators maintain jurisdiction of final grades, which may be at variance with suggested grades offered by principal investigators. 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 PI 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 PI 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 495. At the end of the spring term a Satisfactory grade in MCDB 495 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 495, they will not be permitted to continue to MCDB 496.

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 during fall 2022 or spring 2023 semesters, 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]

Given the research-intensive nature of this degree, the best option is to fulfill the Senior Requirement with 4 credits of independent research. No accommodations will be allowed for the BS Intensive degree and BS/MS degree.

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MCDB 470 – Tutorial in MCDB

Offered fall 2022 and spring 2023. 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

TBD (spring 2023). 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.