Information for
MB&B Intensive Research Courses for BS/MS Majors

MB&B 570a and 571b
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Two-term independent research projects under faculty supervision toward joint BS/MS degrees.

Application

1. To register for these two-credit intensive independent research courses, the student must apply for and be admitted into the BS/MS program. Application deadlines are at the end of the Fall term of the student's Junior year. The application for admission to the BS/MS program can be downloaded from the MB&B undergraduate web site
2. A student must be sponsored by a faculty member, who will guide the project.

Selection of Research Supervisor and Research Project.

1. The faculty advisor for the BS/MS degree should be identified no later than the Spring semester of the Junior year. The student should work in the lab of this advisor at some point (a summer research project or at least one semester of research for credit during the school year) PIOR to the senior year to ensure that the advisor and lab will be suitable.

2. Students may carry out research in the lab of an MB&B faculty member, or a student may also perform biochemical, biophysical or molecular biological research with a full-time member of a department other than MB&B with the consultation and permission of the MB&B Faculty Advisor. Information on research opportunities both within and outside of MB&B can be viewed at the web site for the Yale Combined Program in Biological and Biomedical Sciences (http://info.med.yale.edu/bbs/main.html).

3. To select a Research Supervisor, the student should make appointments to discuss research opportunities with one or more faculty members, preferably several weeks in advance of the planned research start date.

5. Acceptance of a particular student into a laboratory is solely by decision of the Faculty Research Supervisor. It will depend upon several factors including: the qualifications of the individual for the proposed research, the completion of laboratory courses, and the availability of space.

Hour Requirement.

The student is required to work **20 hours per week on the project for both semesters**.

Work for Pay

Simultaneous research for double-credit and laboratory work for pay is prohibited.

Course Requirements.

The 570a, 571b series is a year-long opportunity to perform independent research in a cutting edge scientific environment and prepare a Masters Thesis. As such, the requirements of these courses are arranged as a year long program, with different expectations each semester.

MB&B 570a Fall Semester

To register in the Fall of the senior year, the student must complete the BSMS Research Registration form and submit it to the DUS Registrar's Office **by the date the student's course schedule is due.** By signing this form, the student and supervisor agree to the terms of the program.

1. Research Proposal (30% of overall grade).

•The student must submit by **the first Friday in October**, an original typed research proposal describing the project. The text of the proposal must be single-spaced in 12 point font and must not exceed two pages of text, one page of bibliography and one page of figures. The proposal must include the following elements:

a. *Hypothesis*. One or two sentences about the project's focus, **stated in the form of a question**.
b. *Background Information*. Two or three paragraphs describing the current state of the field and the scientific context for the project.
c. *Specific aim(s)*. A list of the research project goals with an explanation of how they will be achieved. Items *a-c* must fit within the two page limit.
d. *Bibliography*. A list of 5-10 articles (including title, authors, journal name, volume, year, and page numbers) that provide the background and the context for the project. These references must be numbered and cited within the proposal description. The student must have read these papers. The bibliography should be included on page 3.
e. *Figure*. One figure that helps clarify or explain the proposal. The figure must include a caption describing the contents of the figure. The figure should be included on page. 4.

•The proposal will be graded by the Instructor in Charge based upon:

a. *Compliance with proposal guidelines*
b. *Clarity of the scientific writing*
c. *Demonstrated understanding of the project's rationale*

•The grade on the proposal will constitute 30% of the overall grade in the course.
•Students are strongly encouraged to retrieve the research proposal from the DUS office after it has been graded in order to improve the quality of the Masters Thesis.

2. Group Seminar (40% of overall grade).

•The student must make a 12-15 min. oral presentation of the research progress to the Research Supervisor and his/her research group.
•The presentation must be made within two weeks prior to the first day of reading week.
•The presentation will be graded by the Research Supervisor based upon the following criteria:

a. Did the student demonstrate an understanding of the scientific background of the project?
b. Did the student provide a clear description of the original data generated during the semester?
c. Did the student correctly interpret these data?
d. Did the student identify an appropriate set of follow-up experiments?
e. Was the overall presentation well organized and clear?

•The grade on the presentation will count toward 40% of the overall grade in the course.

3. Satisfactory Research Progress (30% of overall grade).

•The Research Supervisor will provide a grade to access the student's progress and effort toward completion of the Masters thesis.

•No research report is required for completion of 570a in the first semester.

MB&B 571b Spring Semester

1. Research Presentation (40% of overall grade)

•The student must make a 20-minute oral presentation which is open to MB&B faculty, staff and students.

•These presentations will be scheduled within the final exam period - the instructor in charge will schedule a workable time around the exam schedules of the students involved.

•As this presentation takes the place of the Senior Seminar, students are expected to attend the presentations made by their peers in the BS/MS program.

•The presentation will be graded equally and independently by the Research Supervisor and the Instructor in Charge (20% of overall grade each) based upon the same criteria used for the group seminar in the Fall term.

2. Masters Thesis (60% of overall grade)

•The student must prepare a 50-60 page double-spaced Masters Thesis (text of approximately 12,000 words) including bibliography and figures. The Thesis must describe the basis for the laboratory work, summarize the data collected over the course of the project and describe any conclusions supported by the data.

•Printed copies of the Thesis must be submitted to the Research Supervisor and the Instructor in Charge **no later than the last day of the Yale College Reading Period**. An electronic version of the document should also be submitted to the Instructor in Charge.

•The Thesis must include the following components:

a *Title Page*. Title, the name and department of the faculty member in whose laboratory the project was performed, the name of the student, and the statement, "A Thesis Presented to the Department of Molecular Biophysics and Biochemistry, Yale University, in Candidacy for the Degrees of B.S./M.S., May 2003".

b *Table of Contents*. One page with page numbers for each section.

c. *Abstract*. A one paragraph summary of the Thesis, including the scientific context of the work and its primary conclusions. This abstract should be 300 words or less.

d. *Introduction*. Scientific background for the Thesis project including a summary of the literature in the field and a justification that leads into the experiments that were performed.

e. *Methods*. A brief description or literature references to outline the experimental methods employed. Clarity and brevity in this section is critical. The methods section must be less than five pages (<1500 words) in length, unless the Master Thesis project is focused primarily upon methods development, in which case there is no specific limit.

f. *Results*. Description of experimental results and variables investigated. Include tables, charts or figures to summarize the data. Please write the results under the assumption that the reader has skipped reading your Methods section and was planning to just refer back to the Methods if they want to be filled in on technical details of your experiments. Thus your Results section should be a fully self-contained narrative that gives the reader the main concepts behind your experimental design.

g. *Discussion*. Interpretation of the experimental data in relation to the scientific knowledge in the field and to the question posed in the original hypothesis in the research proposal.

h. *Bibliography*. A complete bibliography for the thesis. Referencing should be in the format used by the journal *Cell*, i.e. references are noted in the text by the last author and publication year, and then listed in the bibliography alphabetically by last author,

with each entry including the authors, title, journal name, volume, year and page numbers. Alternatively, the references can in the style of the journal *Nature*, i.e. references are noted in the text by number in the order they are first mentioned, and then listed in order by number in the bibliography. Again, each bibliography entry should include the authors, title, journal name, volume, year and page numbers.

i. *Figures and Figure legends*. Captions that describe the contents of each figure. Figures and their legends be incorporated into the document at the point they are described in the text.

•The Masters Thesis must be the original work of the student. Where appropriate, the Thesis can utilize material from the research proposal, but the grade on the Thesis will be reduced if errors identified in the grading of the research proposal are not corrected in the Thesis.
•It is appropriate for the student to receive feedback on early drafts of the report from peers or other members of the laboratory. The oral presentations are an ideal opportunity for the student to receive critical feedback on the project. However, the Thesis must remain the original work of the student.
•The Thesis must follow appropriate practices for referencing the published or unpublished work of others.
•The following criteria will be used to assign the grade on the Thesis:

a. Did the student follow the Thesis guidelines?
b. Did the student demonstrate an understanding of the scientific background of the project?
c. Did the student provide a clear description of the original data generated during the year of research?
d. Did the student correctly interpret these data?
e. Was the overall presentation of the Thesis well organized and clear?

•The Masters Thesis will be graded equally and independently by both the Research Supervisor and the Instructor in Charge of the course (30% each, for a total of 60% of the overall grade).